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Final Environmental Impact Statement for Combined Licenses (COLs) for William States Lee III Nuclear Station Units 1 and 2

U.S. Nuclear Regulatory Commission
Office of New Reactors
Washington, DC 20555-0001

Regulatory Division
Special Projects Branch
Charleston District
U.S. Army Corps of Engineers
Charleston, SC 29403-5107

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Abstract

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by Duke Energy Carolinas, LLC (Duke) for two combined construction permits and operating licenses (combined licenses or COLs). The proposed actions requested in Duke's application are (1) NRC issuance of COLs for two nuclear power reactors at the William States Lee III Nuclear Station (Lee Nuclear Station) site in Cherokee County, South Carolina, and (2) U.S. Army Corps of Engineers (USACE) permit action on a Department of the Army individual permit application to perform certain construction activities on the site. The USACE is participating with the NRC in preparing this EIS as a cooperating agency and participates collaboratively on the review team.

This EIS includes the review team's analysis that considers and weighs the environmental impacts of building and operating two new nuclear units at the proposed Lee Nuclear Station site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts. The EIS also addresses Federally listed species, cultural resources, and plant cooling-system design alternatives.

The EIS includes the evaluation of the proposed project's impacts on waters of the United States pursuant to Section 404 of the Clean Water Act. The USACE will conduct a public interest review in accordance with the guidelines promulgated by the U.S. Environmental Protection Agency under authority of Section 404(b) of the Clean Water Act. The public interest review, which will be addressed in the USACE's permit decision document, will include an alternatives analysis to determine the least environmentally damaging practicable alternative.

After considering the environmental aspects of the proposed NRC action, the NRC staff's recommendation to the Commission is that the COLs be issued as requested.[a] This recommendation is based on (1) the application, including Revision 1 of the environmental report (ER) and the supplement to the ER, submitted by Duke; (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the two public scoping processes and the draft EIS comment period; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. The USACE will issue its Record of Decision based, in part, on this EIS.

(a) As directed by the Commission in CLI-12-16, the NRC will not issue the COLs prior to completion of the ongoing rulemaking to update the Waste Confidence Decision and Rule (see Section 6.1.6 of this EIS).

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Executive Summary

This environmental impact statement (EIS) presents the results of an U.S. Nuclear Regulatory Commission (NRC) environmental review of an application for combined construction permits and operating licenses (combined licenses or COLs) for two new nuclear reactor units at a proposed site in Cherokee County, South Carolina. The U.S. Army Corps of Engineers (USACE) participated in the preparation of the EIS as a cooperating agency and as a member of the review team, which consisted of the NRC staff, its contractor staff, and the USACE staff.

Background

On December 12, 2007, Duke Energy Carolinas, LLC (Duke), submitted an application to the NRC for COLs for William States Lee III Nuclear Station (Lee Nuclear Station) Units 1 and 2 in Cherokee County, South Carolina. The application was revised (Revision 1) by a letter dated March 30, 2009, and a supplement to the environmental report (ER) was submitted on September 24, 2009, describing Duke's plans to construct and operate an additional offsite reservoir (known as Make-Up Pond C) as a source of supplemental cooling water for the proposed station.

Upon docketing of Duke's initial application, the NRC review team began the environmental review process as described in 10 CFR Part 51 by publishing in the *Federal Register* on March 20, 2008, a Notice of Intent to prepare an EIS and conduct scoping. With the submittal of the September 2009 supplement to the ER, a second Notice of Intent to conduct a supplemental scoping process was published in the *Federal Register* on May 24, 2010. As part of the environmental review, the review team:

- considered comments received during the 60-day scoping process beginning March 20, 2008, and conducted related public scoping meetings on May 1, 2008 in Gaffney, South Carolina.
- considered comments received during a supplemental scoping period specific to Make-Up Pond C from May 24, 2010 through July 2, 2010, and conducted a related public scoping meeting on June 17, 2010, also in Gaffney, South Carolina.
- conducted site audits from April 28, 2008 through May 2, 2008 and from August 9, 2010 through August 13, 2010.
- conducted public meetings on the draft EIS on January 19, 2011 in Gaffney, South Carolina. The review team also considered comments received during the 75-day comment period for the draft EIS beginning on December 12, 2011.

- reviewed Duke's ER and Supplemental ER and developed requests for additional information (RAIs) using guidance from NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants."
- consulted with American Indian Tribes and Federal and State agencies such as U.S. Fish and Wildlife Service, Advisory Council on Historic Preservation, National Marine Fisheries Service, Federal Energy Regulatory Commission, South Carolina Department of Natural Resources, South Carolina Department of Health and Environmental Control, and South Carolina Archives and History Center.

Proposed Action

The proposed actions related to the Lee Nuclear Station Units 1 and 2 application are (1) NRC issuance of COLs for construction and operation of two new nuclear plants at the Lee Nuclear Station site and (2) USACE issuance of a permit pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) as amended to perform certain construction activities on the site.

Purpose and Need for Action

The purpose of the proposed action—issuance of the COLs—is to construct and operate two new nuclear units to provide for additional baseload electric generating capacity in 2024 and 2026 within Duke's service territories. The objective of Duke's requested USACE action is to obtain a Department of the Army individual permit to perform regulated dredge-and-fill activities that would affect wetlands and other waters of the United States.

Public Involvement

A 60-day scoping period was held from March 20, 2008 through May 20, 2008. A supplemental scoping period specific to Make-Up Pond C was held from May 24, 2010 through July 2, 2010. On June 17, 2010, the NRC held supplemental public scoping meetings in Gaffney, South Carolina. The review team received many oral comments during the public meetings and a total of 35 e-mails and 14 letters from both scoping periods on topics such as surface-water hydrology, ecology, socioeconomics, uranium fuel cycle, energy alternatives, and benefit-cost balance.

Additionally, on January 19, 2012, during the 75-day comment period on the draft EIS, the review team held public meetings in Gaffney, South Carolina. Approximately 250 people attended the public meetings and many provided oral comments.

Affected Environment

As proposed, the Lee Nuclear Station would be constructed in Cherokee County, South Carolina, on the same site as the former Duke Power Company Cherokee Nuclear Station. The site is 8 mi southeast of Gaffney, South Carolina and 25 mi northeast of Spartanburg, South Carolina. The area around the site is shown in Figure ES-1.

Cooling water for the units would be obtained from the Broad River. Makeup water from the Broad River would be provided to the plant via Make-Up Pond A. During periods of low flow when withdrawals from the Broad River are limited, makeup water would be provided from Make-Up Ponds B and C to Make-Up Pond A. Make-Up Ponds A and B already exist on the Lee Nuclear Station site. Make-Up Pond C would be built on the London Creek watershed to the northeast of the site. Construction of Make-Up Pond C would disturb approximately 1100 ac with permanent or temporary loss and alteration from flooding and clearing.

The Lee Nuclear Station would use mechanical draft cooling towers to transfer waste heat to the atmosphere. A portion of the water obtained from the Broad River would be returned to the environment via a discharge structure located in the Broad River on the upstream side of Ninety-Nine Islands Dam. The remaining portion of the water would be released to the atmosphere via evaporative cooling.

Evaluation of Environmental Impacts

When evaluating the environmental impacts associated with nuclear power plant construction and operations, the NRC's authority is limited to construction activities related to radiological health and safety or common defense and security; that is, NRC-authorized activities are related to safety-related structures, systems, or components, and may include pile driving; subsurface preparation; placement of backfill, concrete, or permanent retaining walls within an excavation; installation of foundations; or in-place assembly, erection, fabrication, or testing. In this EIS, the NRC review team evaluates the potential environmental impacts of the construction and operation of two new nuclear units for the following resource areas:

- land use
- air quality
- aquatic ecology
- terrestrial ecology
- surface and groundwater
- waste (radiological and nonradiological)
- human health (radiological and nonradiological)
- socioeconomics
- environmental justice
- cultural resources

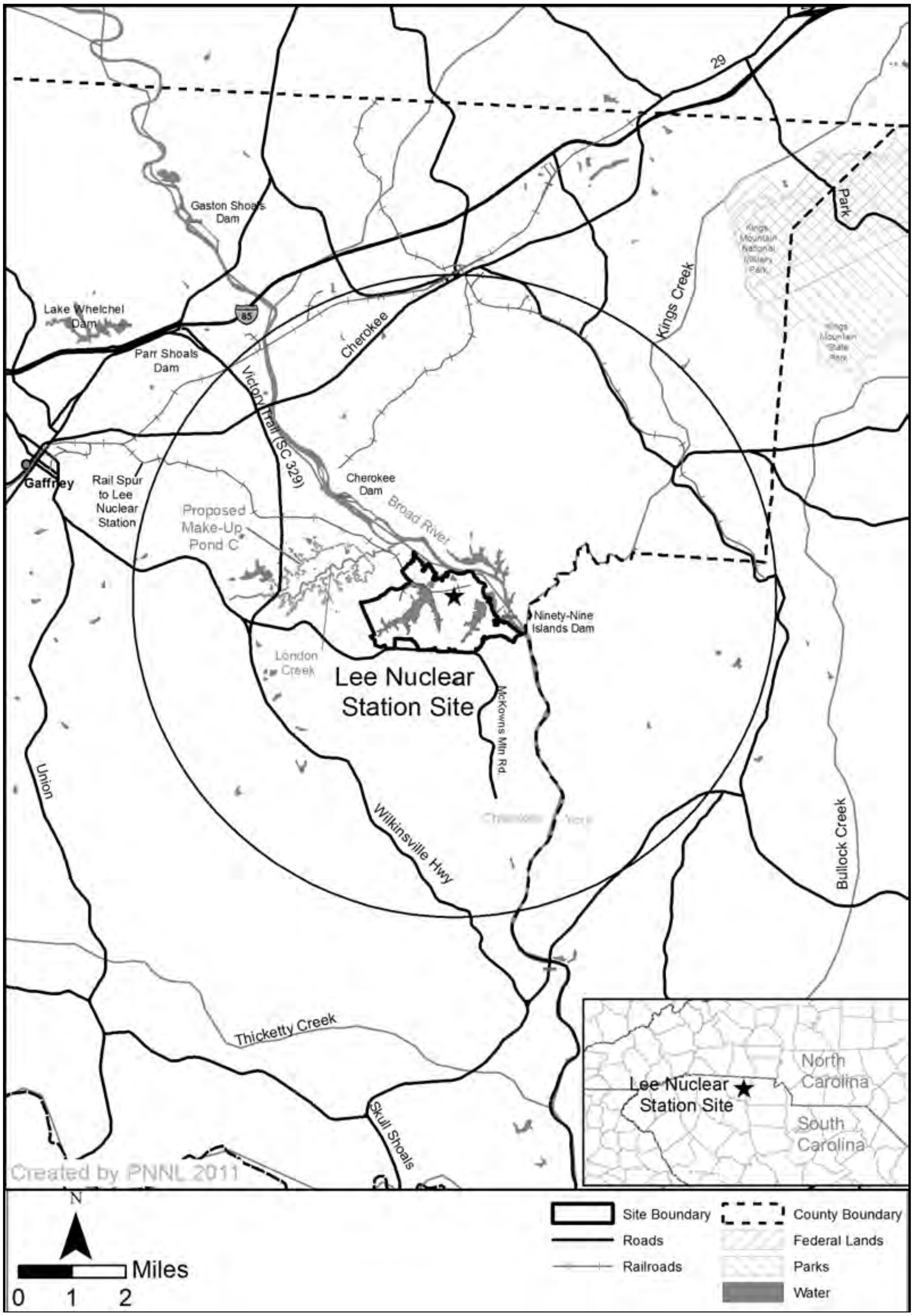

Figure ES-1. Lee Nuclear Station Site

It also evaluates impacts associated with accidents, the fuel cycle, decommissioning, and transportation of radioactive materials.

> **SMALL:** Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> **MODERATE**: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> **LARGE**: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impacts are designated as SMALL, MODERATE, or LARGE. The incremental impacts related to the construction and operations activities requiring NRC authorization are described and characterized, as are the cumulative impacts resulting from the proposed action when the effects are added to, or interact with, other past, present, and reasonably foreseeable future effects on the same resources.

The review team found that the cumulative environmental impacts on most aspects of water use and quality, most socioeconomic areas (adverse only), environmental justice, nonradiological and radiological health, severe accidents, fuel cycle, decommissioning, and transportation would be SMALL. The cumulative impacts for physical impacts and infrastructure and community services would be SMALL to MODERATE.

The review team found that the cumulative environmental impacts on land use, surface-water use, terrestrial and wetland ecosystems, aquatic ecosystems, air quality, and historic and cultural resources would be MODERATE. The impacts from NRC-authorized activities would be SMALL for all of the above-listed resource areas. The incremental impacts associated with the development of transmission lines and Make-Up Pond C would be the principal contributors to the MODERATE cumulative land-use impacts. Potential future water-supply issues in the Broad River Basin would be the primary driver for the MODERATE impact for surface-water use. Cumulative terrestrial and wetland ecosystem impacts would be MODERATE because of the loss of habitat from development of transmission-line corridors. The development of Make-Up Pond C would have cumulative aquatic ecosystem impacts on London Creek and its tributaries. The MODERATE cumulative impact on air quality would result from the existing concentration of greenhouse gases in the atmosphere. The review team found cumulative impacts from Make-Up Pond C development and transmission-line corridor development would contribute to the MODERATE impact for historic and cultural resources.

The review team found no LARGE, adverse cumulative impacts.

Table ES-1 provides a summary of the cumulative impacts for the proposed site.

Table ES-1. Cumulative Impacts on Environmental Resources, Including the Impacts of Proposed Lee Nuclear Station

Resource Category	Impact Level
Land use	MODERATE
Water-related	
Surface-water use	MODERATE
Groundwater use	SMALL
Surface-water quality	SMALL
Groundwater quality	SMALL
Ecology	
Terrestrial ecosystems	MODERATE
Aquatic ecosystems	MODERATE
Socioeconomic	
Physical impacts	SMALL to MODERATE
Demography	SMALL
Economic impacts on the community	SMALL to LARGE (beneficial)
Infrastructure and community services	SMALL to MODERATE
Aesthetics and recreation	SMALL
Environmental justice	SMALL
Historic and cultural resources	MODERATE
Air quality	MODERATE
Nonradiological health	SMALL
Radiological health	SMALL
Severe accidents	SMALL
Fuel cycle, transportation, and decommissioning	SMALL

Alternatives

The review team considered the environmental impacts associated with alternatives to issuing COLs for Lee Nuclear Station. These alternatives included a no-action alternative (i.e., not issuing the COLs), and alternative energy sources, siting locations, or system designs.

The **no-action alternative** would result in the COLs not being granted or the USACE not issuing its permit. Upon such a denial, construction and operation of the two units at the Lee Nuclear Station site would not occur and the predicted environmental impacts would not take place. If no other facility would be built or strategy implemented to take its place, the benefits of the additional electrical capacity and electricity generation to be provided would also not occur and the need for baseload power would not be met.

Based on the review team's review of **energy alternatives**, the review team concluded that, from an environmental perspective, none of the viable alternatives is clearly environmentally preferable to building a new baseload nuclear power generation plant at the Lee Nuclear Station site. The review team eliminated several energy sources (i.e., wind, solar, and biomass) from full consideration because they are not currently capable of meeting the need of this project. None of the viable baseload alternatives (natural gas, coal, or a combination of alternatives) was environmentally preferable to the proposed nuclear units.

After comparing the cumulative effects of the proposed site against those of the **alternative sites**, the review team concluded that none of the alternative sites would be environmentally preferable to the proposed site for building and operating a new nuclear power plant. The three alternatives sites selected were the following:

- Perkins site (previously considered for the Perkins Nuclear Station), Davie County, North Carolina (Figure ES-2),
- Keowee site (adjacent to Oconee Nuclear Station), Oconee County, South Carolina (Figure ES-3),
- Middleton Shoals site, Anderson County, South Carolina (Figure ES-4).

Table ES-2 provides a summary of the cumulative impacts for the alternative sites. The review team concluded that all of the sites were generally comparable, and it would be difficult to state that one site is preferable to another from an environmental perspective. In such a case, the proposed site prevails because none of the alternatives is clearly environmentally preferable.

The review team considered various **alternative systems designs**, including seven alternative heat-dissipation systems and multiple alternative intake, discharge, and water-supply systems. The review team identified no alternatives that were environmentally preferable to the proposed Lee Nuclear Station plant systems design.

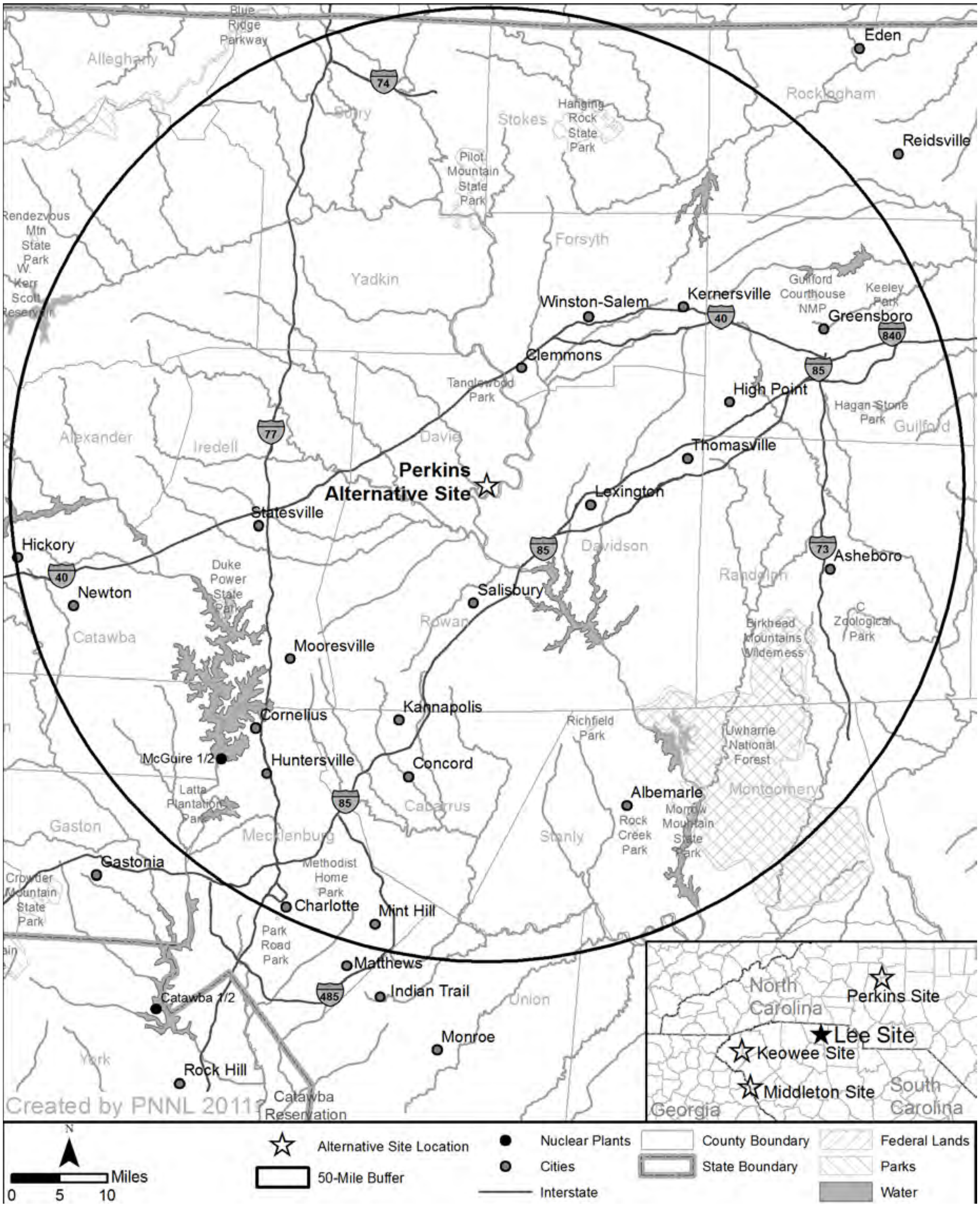

Figure ES-2. Perkins Site

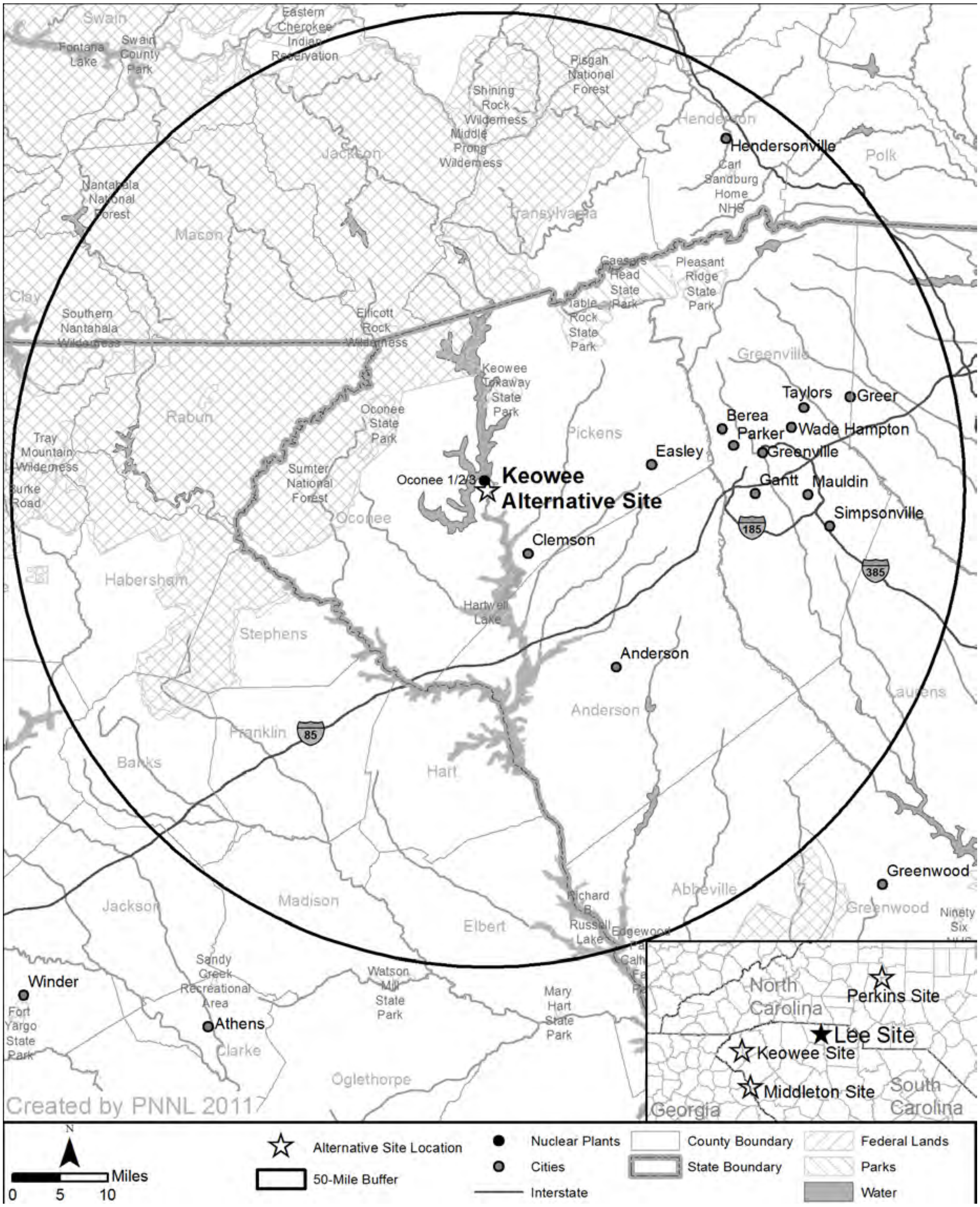

Figure ES-3. Keowee Site

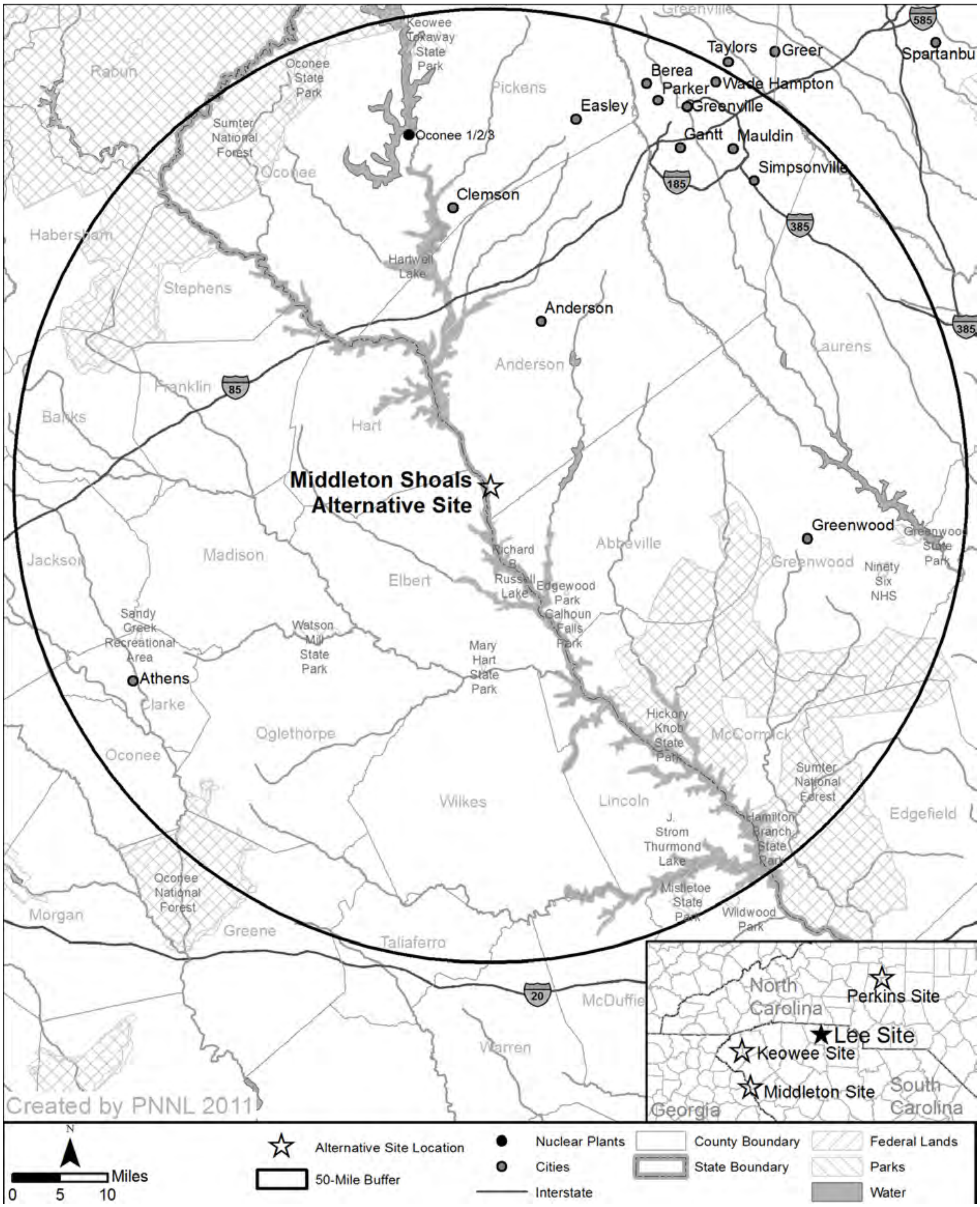

Figure ES-4. Middleton Shoals Site

Benefits and Costs

The review team compiled and compared the pertinent analytical conclusions reached in the EIS. It gathered all of the expected impacts from building and operating the proposed Lee Nuclear Station and aggregated them into two final categories: (1) the expected environmental costs and (2) the expected benefits to be derived from approval of the proposed action. Although the analysis in Section 10.6 is conceptually similar to a purely economic benefit-cost analysis, which determines the net present dollar value of a given project, the intent of the section is to identify potential societal benefits of the proposed activities and compare them to the potential internal (i.e., private) and external (i.e., societal) costs of the proposed activities. In general, the purpose is to inform the COL process by gathering and reviewing information that demonstrates the likelihood that the benefits of the proposed activities outweigh the aggregate costs.

On the basis of the assessments in this EIS, the building and operation of the proposed Lee Nuclear Station, with mitigation measures identified by the review team, would accrue benefits that most likely would outweigh the economic, environmental, and social costs. For the NRC-proposed action (i.e., NRC-authorized construction and operation), the accrued benefits would also outweigh the costs of preconstruction, construction, and operation of the proposed Lee Nuclear Station.

Recommendation

The NRC's recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs should be issued as proposed.

This recommendation is based on the following:

- the application, including the ER and its revisions, submitted by Duke
- consultation with Federal, State, Tribal, and local agencies
- consideration of public comments received during scoping and on the draft EIS
- the review team's independent review and assessment detailed in this EIS.

In making its recommendation, the review team determined that none of the alternative sites is environmentally preferable (and, therefore, also not obviously superior) to the Lee Nuclear Station site. The review team also determined that none of the energy or cooling-system alternatives assessed is environmentally preferable to the proposed action.

The NRC's determination is independent of the USACE's determination of whether the Lee Nuclear Station site is the least environmentally damaging practicable alternative pursuant to Clean Water Act Section 404(b) (1) Guidelines. The USACE will conclude its analysis of both offsite and onsite alternatives in its Record of Decision.

Table ES-2 provides a summary of the EIS-derived cumulative impacts for the proposed site in comparison with the no-action alternative, alternative sites, and energy alternatives.

Table ES-2. Comparison of Environmental Impacts

	Proposed Site[(a)]	Alternative Sites[(b)]			Energy Alternatives[(c)]		
Resource Areas	**Lee**	**Perkins**	**Keowee**	**Middleton Shoals**	**Coal**	**Natural Gas**	**Combination**
Land Use	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Surface Water	MODERATE	MODERATE	MODERATE	MODERATE	SMALL	SMALL	SMALL
Groundwater	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Aquatic Ecosystems	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Terrestrial Ecosystems	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Air Quality	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Socioeconomics	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to MODERATE (beneficial)	MODERATE (adverse) to MODERATE (beneficial)
Environmental Justice	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Cultural Resources	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Human Health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Waste Management	SMALL	SMALL	SMALL	SMALL	MODERATE	SMALL	SMALL

(a) Cumulative impact determinations taken from Table 7-4 in the EIS.
(b) Cumulative impact determinations taken from Table 9-18 in the EIS.
(c) Impacts taken from Table 9-4 in the EIS. These conclusions for energy alternatives should be compared to NRC-authorized activities reflected in Chapters 4, 5, 6.1, and 6.2.

Abbreviations/Acronyms

7Q10	lowest flow for 7 consecutive days expected to occur once per decade
AADT	annual average daily traffic
ac	acre(s)
ac-ft	acre feet
ACS	American Community Survey
AD	Anno Domini
ADAMS	Agencywide Documents Access and Management System
ALARA	as low as reasonably achievable
AP1000	Advanced Passive 1000 pressurized water reactor
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ARRA	American Recovery and Reinvestment Act of 2009
BACT	Best Available Control Technologies
BC	before Christ
BEA	Bureau of Economic Analysis
BEIR	Biological Effects of Ionizing Radiation
BGEPA	Bald and Golden Eagle Protection Act
BLS	Bureau of Labor Statistics
BMP	best management practice
BOD	biochemical oxygen demand
Bq	becquerel(s)
Btu	British thermal unit(s)
°C	degree(s) Celsius
CAES	compressed air-energy storage
CAIR	Clean Air Interstate Rule
CDC	U.S. Centers for Disease Control and Prevention
CDF	core damage frequency
CESQG	conditionally exempt small quantity generator
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic foot/feet per second
Ci	curie(s)
cm	centimeter(s)
CMC	criterion maximum concentration
CO	carbon monoxide
CO_2	carbon dioxide

COL	combined construction permit and operating license
CORMIX	Cornell Mixing Zone Expert System
CPCN	Certificate of Environmental Compatibility and Public Convenience and Necessity
CSAPR	Cross-State Air Pollution Rule
CWA	Clean Water Act (aka Federal Water Pollution Control Act)
CWS	circulating-water system
d	day(s)
DA	Department of the Army
dB	decibel(s)
dBA	decibel(s) on the A-weighted scale
DBA	design basis accident
DBH	diameter breast high
DCD	Design Control Document
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
D/Q	deposition factor(s); annual normalized total surface concentration rate(s)
DSM	demand-side management
DTA	Devine Tarbell & Associates
Duke	Duke Energy Carolinas, LLC
Duke Energy	Duke Energy Corporation
EAB	exclusion area boundary
EE	energy efficiency
EECBG	Energy Efficiency and Conservation Block Grant
EIA	Energy Information Administration
EIS	environmental impact statement
ELF	extremely low frequency
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPT	Ephemeroptera-Plecoptera-Trichoptera (Index)
ER	environmental report
ESP	Early Site Permit
ESRP	Environmental Standard Review Plan
°F	degree(s) Fahrenheit
FAA	Federal Aviation Administration
FES	Final Environmental Statement
FEIS	Final Environmental Impact Statement

FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FP&S	Facilities Planning & Siting
fps	foot (feet) per second
FR	*Federal Register*
FSAR	Final Safety Analysis Report
FSER	Final Safety Evaluation Report
ft	foot/feet
ft^2	square foot/feet
ft^3	cubic foot/feet
FWS	U.S. Fish and Wildlife Service
μg	microgram(s)
g	gram(s)
gal	gallon(s)
GC	gas centrifuge
GCRP	U.S. Global Change Research Program
GD	gaseous diffusion
GDNR	Georgia Department of Natural Resources
GEIS	Generic Environmental Impact Statement
GHG	greenhouse gas
GIS	geographic information system
gpd	gallon(s) per day
gpm	gallon(s) per minute
GWh	gigawatt-hours
HAP	hazardous air pollutant
HDPE	high-density polyethylene
HLW	high-level waste
hr	hour(s)
Hz	hertz
HZI	hydraulic zone of influence
I	U.S. Interstate
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IGCC	integrated gasification combined cycle
in.	inch(es)
INEEL	Idaho National Engineering and Environmental Laboratory
IRP	Integrated Resource Plan
IRWST	in-containment refueling water storage tank

ISFSI	independent spent fuel storage installation
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
km/hr	kilometer(s) per hour
kV	kilovolt(s)
kW	kilowatt(s)
kW(e)	kilowatt(s) electric
kWh	kilowatt-hour(s)
L	liter(s)
LEDPA	least environmentally damaging practicable alternative
LFG	landfill-based gas
LLC	Limited Liability Company
LLW	low-level waste
LOS	level of service
LPZ	low-population zone
LWA	Limited Work Authorization
LWR	light water reactor
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
m^3/s	cubic meter(s) per second
MACCS2	Melcor Accident Consequence Code System Version 1.12
mg	milligram(s)
MEI	maximally exposed individual
Mgd	million gallon(s) per day
mGy	milligray(s)
mi	mile(s)
mi^2	square mile(s)
mL	milliliter(s)
mm	millimeter(s)
MMS	U.S. Department of Interior Minerals Management Service
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MOX	mixed oxides
mpg	mile(s) per gallon
mph	mile(s) per hour
mrad	millirad

mrem	millirem
MSDS	material safety data sheets
MSL	mean sea level
mSv	millisievert(s)
MSW	municipal solid waste
MT	metric ton(nes)
MTU	metric ton(nes) uranium
MW	megawatt(s)
MW(e)	megawatt(s) electric
MWh	megawatt-hour(s)
MW(t)	megawatt(s) thermal
MWd	megawatt-day(s)
MWd/MTU	megawatt-days per metric ton of uranium
NA	not applicable
NAAQS	National Ambient Air Quality Standard
NAGPRA	Native American Graves Protection and Repatriation Act
NC	North Carolina
NCDENR	North Carolina Department of Environment and Natural Resources
NCI	National Cancer Institute
NCRP	National Council on Radiation Protection and Measurements
NCUC	North Carolina Utility Commission
NCWRC	North Carolina Wildlife Resources Commission
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act of 1969, as amended
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NGCC	natural gas combined cycle
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NSPS	new source performance standard
NSR	new source review

NUREG	U.S. Nuclear Regulatory Commission technical document
NVC	National Vegetation Classification
NWI	National Wetlands Inventory
NWS	National Weather Service
OCS	outer continental shelf
ODCM	Offsite Dose Calculation Manual
OECD	Organization for Economic Cooperation and Development
OSHA	Occupational Safety and Health Administration
pH	measure of acidity or basicity in solution
PIRF	public interest review factor
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter 2.5 microns or less
PNNL	Pacific Northwest National Laboratory
pp.	pages
ppb	part(s) per billion
ppm	part(s) per million
PRA	probabilistic risk assessment
PSCSC	Public Service Commission of South Carolina
PSD	Prevention of Significant Deterioration (Permit)
PUC	public utility commission
PURC	Public Utility Review Committee
PURPA	Public Utility Regulatory Policies Act of 1978
PV	photovoltaic
PWR	pressurized water reactor
PWS	potable water service
rad	radiation absorbed dose
RAI	Request(s) for Additional Information
RCRA	Resource Conservation and Recovery Act of 1976, as amended
REC	renewable energy credit(s)
rem	roentgen equivalent man
REMP	radiological environmental monitoring program
REPS	renewable energy portfolio standard(s)
RFP	request for proposal
RIMS II	Regional Input-Output Modeling System
RM	river mile
ROI	region of interest

ROW	right-of-way
RRS	(SERC's) Reliability Review Subcommittee
RWS	raw water service
Ryr	reactor year
μS/cm	microsievert(s) per centimeter
s or sec	second(s)
SACTI	Seasonal/Annual Cooling Tower Impact (prediction code)
SAMA	severe accident mitigation alternative
SAMDA	severe accident mitigation design alternative
SC	South Carolina
SCBCB	South Carolina Budget and Control Board
SCDAH	South Carolina Department of Archives and History
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCDOT	South Carolina Department of Transportation
SCDSS	South Carolina Department of Social Services
SCE&G	South Carolina Electric and Gas
SCIAA	South Carolina Institute of Archaeology and Anthropology
SCR	selective catalytic reduction
SDS	sanitary drainage system
SER	Safety Evaluation Report
SERC	Southeastern Electric Reliability Council
SHA	seismic hazard analysis
SHPO	State Historic Preservation Office (or Officer)
SMCL	secondary maximum concentration limits
SO_2	sulfur dioxide
SO_x	oxides of sulfur
SPCCP	Spill prevention, control, and countermeasure plan
SRS	Savannah River Site
Sv	sievert(s)
SWPPP	stormwater pollution prevention plan
SWS	service-water system
T	ton(s)
T&E	threatened and endangered
TDS	total dissolved solids
TEDE	total effective dose equivalent
THPO	Tribal Historic Preservation Officer
TRAGIS	Transportation Routing Analysis Geographic Information System

TSC	technical support center
UF_6	uranium hexafluoride
UMTRI	University of Michigan Transportation Research Institute
UO_2	uranium dioxide
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
US	U.S. (State Highway)
VACAR	Virginia-Carolinas (subregion)
VCSNS	Virgil C. Summer Nuclear Station
VEGP	Vogtle Electric Generating Plant
VOC	volatile organic compound
WCD	waste confidence decision
Westinghouse	Westinghouse Electric Company, LLC
WWS	wastewater service
χ/Q	atmospheric dispersion factor(s); annual average normalized air concentration value(s)
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)
yr^{-1}	per year

1.0 Introduction

By letter dated December 12, 2007, the U.S. Nuclear Regulatory Commission (NRC or the Commission) received an application from Duke Energy Carolinas, LLC (Duke) for two combined construction permits and operating licenses (combined licenses or COLs) for the proposed William States Lee III Nuclear Station (Lee Nuclear Station) Units 1 and 2 (Duke 2007a). This application was revised (Revision 1) by letter dated March 30, 2009 (Duke 2009a), and a supplement to the environmental report (ER), describing Duke's plans to construct and operate a supplemental cooling-water reservoir (known as Make-Up Pond C), was submitted on September 24, 2009 (Duke 2009b). The NRC staff's review is based on Revision 1 of the ER (Duke 2009c), the supplement to the ER regarding Make-Up Pond C, Duke's responses to the NRC staff's requests for additional information, and supplemental information.

The site proposed by Duke for the two new nuclear units is the Lee Nuclear Station site (Figure 1-1), which is located in the eastern portion of Cherokee County in north-central South Carolina, 40 mi southwest of Charlotte, North Carolina; 25 mi northeast of Spartanburg, South Carolina; and 8 mi southeast of Gaffney, South Carolina. The proposed Lee Nuclear Station would be constructed on the site of the former Duke Power Company Cherokee Nuclear Station, which is owned by Duke (Duke 2009c). In 1978, the NRC granted Duke Power Company permits to construct three 1280-MW(e) pressurized water reactors (PWRs) at the former Cherokee Nuclear Station site. In 1982 and 1983, Duke Power Company canceled the construction of those reactors (NRC 2012a). All of the construction and operation related to proposed Lee Nuclear Station Units 1 and 2 would be completely within the confines of the Lee Nuclear Station site, with four exceptions. Six road-improvement areas and a portion of the railroad spur are offsite. Transmission systems, which will be needed to route power from the proposed Lee Nuclear Station, will not be entirely located onsite (Duke 2009c). In addition, the offsite reservoir (Make-Up Pond C), which is proposed to ensure that the existing limits for downstream flow from Ninety-Nine Islands Reservoir are met (Duke 2009b), is not located on the Lee Nuclear Station site (Duke 2009c).

In November 2011, Duke submitted an application to the U.S. Army Corps of Engineers (USACE) for a Department of the Army individual permit to conduct construction activities that would result in alteration of waters of the United States, including wetlands (Duke 2011h). There are no navigable waters as defined in Section 10 of the Rivers and Harbors Appropriation Act of 1899 (33 U.S.C. 403) in the area that would be affected by the proposed Lee Nuclear Station.

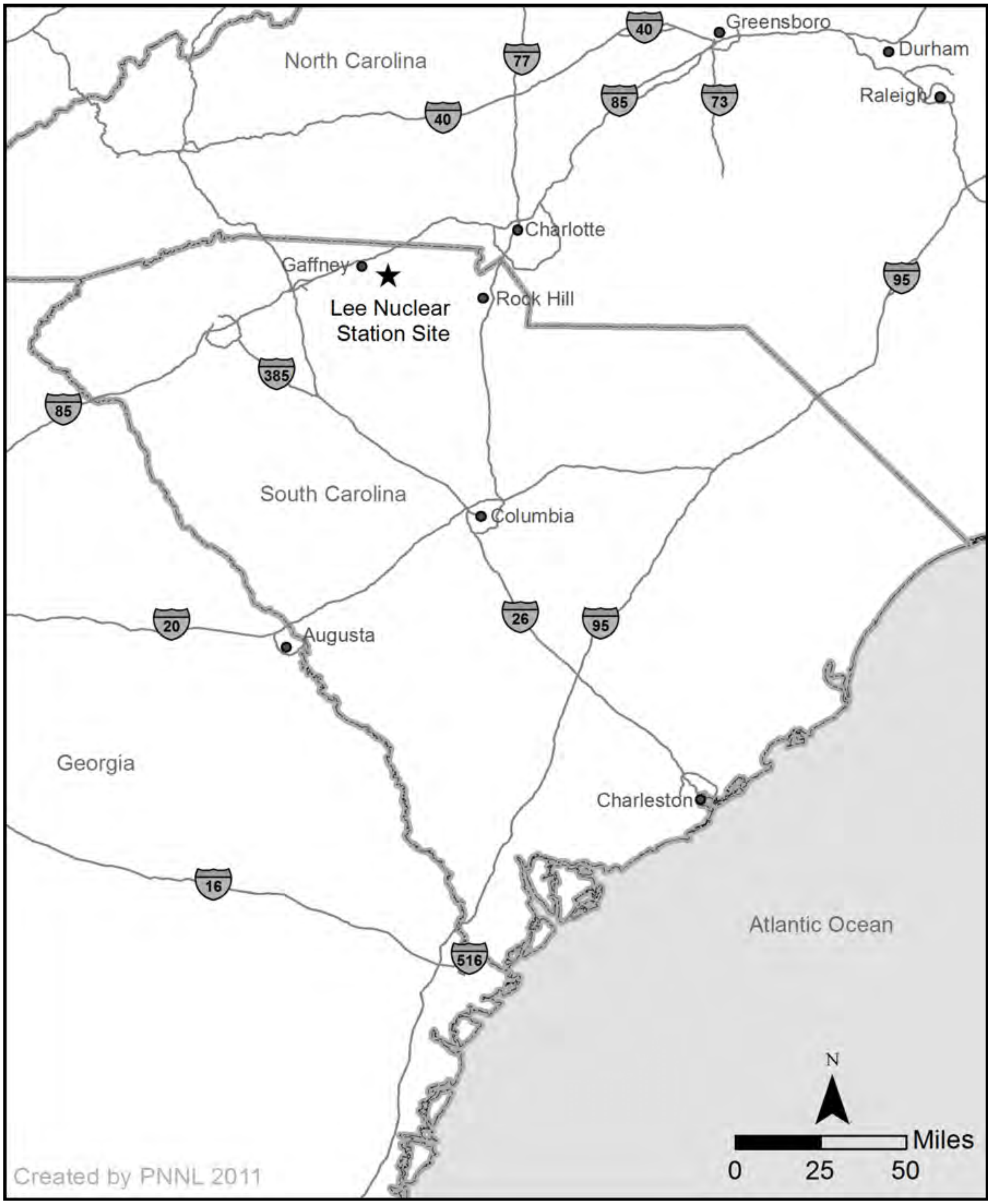

Figure 1-1. Lee Nuclear Station Site Location

The proposed actions in these applications are (1) NRC issuance of COLs for constructing and operating two new nuclear units at the Lee Nuclear Station site, and (2) USACE issuance of permits pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act), as amended (33 U.S.C. 1251 et seq.) to perform certain construction activities on the site. The USACE is participating in the preparation of this environmental impact statement (EIS) as a cooperating agency. The COL and Department of the Army permit applications and NRC and USACE review processes are described in Section 1.1.1.

1.1 Background

A COL is a Commission approval for the construction and operation of a nuclear power facility. NRC regulations related to COLs are found primarily in Title 10 of the *Code of Federal Regulations* (CFR) Part 52, Subpart C.

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. 4321 et seq.) directs that an EIS be prepared for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51. Further, in 10 CFR 51.20, the NRC has determined that the issuance of a COL under 10 CFR Part 52 is an action that requires an EIS.

According to 10 CFR 52.80(b), a COL application must contain an ER. The ER provides the applicant’s input to the NRC’s EIS. NRC regulations related to ERs and EISs are found in 10 CFR Part 51. Part 3 of Revision 1 of Duke’s application contains the ER (Duke 2009c), which, together with the Make-Up Pond C supplement to the ER (Duke 2009b), provides a description of the proposed actions related to the application and the applicant’s analysis of the potential environmental impacts of construction and operation of Lee Nuclear Station Units 1 and 2.

1.1.1 Applications and Reviews

The objective of Duke’s requested NRC action is to obtain two COLs to construct and operate two baseload nuclear power reactors. In addition to the COLs, Duke must obtain and maintain permits from other Federal, State, and local agencies and permitting authorities. The objective of Duke’s requested USACE action is to obtain a Department of the Army individual permit to perform regulated dredge-and-fill activities that would affect wetlands and other waters of the United States. Collectively, the NRC staff (including its contractor staff at Pacific Northwest National Laboratory and Idaho National Laboratory) and USACE staff who reviewed the ER and decided on impact levels are referred to as the “review team” throughout this EIS. Individual contributors to this EIS are listed in Appendix A.

1.1.1.1 NRC COL Application Review

The objective of the NRC environmental review of Duke's application is to determine whether two nuclear reactors of the proposed design can be constructed and operated at the Lee Nuclear Station site. Duke submitted an ER as part of its original COL application (Duke 2007b) that was superseded by Revision 1 of the ER (Duke 2009c) and further modified by the supplement to the ER (Duke 2009b). The ER focuses on the environmental effects of construction and operation of two Westinghouse Advanced Passive 1000 (AP1000) PWRs. NRC regulations that establish standards for review of a COL application are listed in 10 CFR 52.81. Detailed guidance for conducting the environmental portion of the COL review is found in NUREG-1555, the NRC's Environmental Standard Review Plan *(*ESRP*)* (NRC 2000a) and recent updates, hereinafter referred to as the ESRP. Additional guidance on conducting environmental reviews is provided in the NRC Staff Memorandum *Revision 1 - Addressing Construction and Preconstruction, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements* (NRC 2011a).

The Duke COL application references Revision 19 of the Westinghouse AP1000 reactor certified design (Westinghouse 2011). Subpart B of 10 CFR Part 52 contains NRC regulations related to standard design certification. An application for a standard design certification undergoes an extensive review. Revision 19 of the AP1000 design is codified in 10 CFR Part 52, Appendix D, and the final rulemaking for Revision 19 of the AP1000 design was published on December 30, 2011 (76 FR 82079). (Additional information about design certification is discussed in Section 3.2.1.)

In this EIS, the review team evaluates the environmental effects of two Westinghouse AP1000 PWRs at the Lee Nuclear Station site, each with thermal power ratings of 3400 MW(t). In addition to considering the environmental effects of the proposed action, this EIS addresses alternatives to the proposed action, including the no-action alternative and the building and operation of new reactors at alternative sites. The benefits of the proposed action (e.g., meeting an identified need for power) and measures and controls to limit adverse impacts are also evaluated. Duke's proposed action to construct and operate two new nuclear units includes requests for departures from the AP1000 design certification under 10 CFR 52.93. The environmental impacts of the requested departures are addressed in this EIS. The technical analysis for each design certification departure will be included in the NRC's Final Safety Evaluation Report, including a recommendation for approval or denial of each departure.

By letter dated February 25, 2008 (NRC 2008a), the NRC notified Duke that its application was accepted for docketing. Docket numbers 52-018 and 52-019 were established for proposed Units 1 and 2, respectively. After acceptance of Duke's COL application, the NRC began the environmental review process by publishing in the *Federal Register* on March 20, 2008, a

Notice of Intent to prepare an EIS and conduct scoping activities (73 FR 15009), in compliance with requirements set forth in 10 CFR Part 51. On May 1, 2008, a scoping meeting was held in Gaffney, South Carolina, to obtain public input on the scope of the environmental review. After receiving the September 2009 supplement to the ER describing Duke's plans to construct and operate an additional offsite reservoir (Make-Up Pond C) as a source of supplemental cooling water for the proposed Lee Nuclear Station, a second Notice of Intent to conduct a supplemental scoping process was published in the *Federal Register* on May 24, 2010 (75 FR 28822). On June 17, 2010, a second supplemental scoping meeting was held in Gaffney, South Carolina, to obtain public input on the supplement to the ER.

During both the initial and supplemental scoping periods, the NRC contacted Federal, State, Tribal, regional, and local agencies to solicit comments. A list of the organizations contacted is provided in Appendix B. The staff reviewed the comments received during both scoping processes and responses were written for each comment. All comments and responses for comment categories that are within the scope of the NRC environmental review are included in Appendix D. Complete listings of the scoping comments and responses from the initial and supplemental scoping meetings are documented in scoping summary reports (NRC 2008b, NRC 2010a). Meeting summaries of both scoping meetings are also available (NRC 2008c, NRC 2010b).

In April 2008, to gather information and to become familiar with the sites and their environs, the review team visited the preferred Lee Nuclear Station site and the alternative sites (Perkins, Keowee, and Middleton Shoals) (NRC 2008d). In August 2010, the review team revisited the preferred site and alternative sites, including a trip to the proposed, offsite location of Make-Up Pond C (northwest of the Lee Nuclear Station site) (NRC 2010c). During both site visits the review team met with Duke staff; Federal, State, and local officials; and the public. In June 2011, the review team conducted a supplemental audit of cooling system and energy alternatives at Duke's corporate headquarters in Charlotte, North Carolina (NRC 2011b). Documents related to the proposed Lee Nuclear Station and alternative sites were reviewed and are listed as references where appropriate.

To guide its assessment of the environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts based on guidance developed by the Council on Environmental Quality (40 CFR 1508.27). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels established by the NRC – SMALL, MODERATE, and LARGE:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

This EIS presents the review team's analysis, which considers and weighs the environmental impacts of the proposed action at the Lee Nuclear Station site, including the environmental impacts associated with construction and operation of Units 1 and 2, construction and operation of Make-Up Pond C, the impacts of construction and operation of reactors at alternative sites, the environmental impacts of alternatives to granting the COLs, and the mitigation measures available for reducing or avoiding adverse environmental effects presented by the applicant. This EIS also provides the NRC staff's recommendation to the Commission regarding the issuance of the COLs for proposed Lee Nuclear Station Units 1 and 2.

A 75-day comment period on the draft EIS began on December 23, 2011, when the U.S. Environmental Protection Agency (EPA) issued a Notice of Availability of the filing of the draft EIS (76 FR 80367) to allow the public to comment on the results of the review team's review. Two public meetings were held on January 19, 2012, near the site in Gaffney, South Carolina (NRC 2012b. During these public meetings, the NRC staff described the results of the NRC environmental review, provided the public with information to assist them in formulating comments on the draft EIS, responded to questions, and accepted comments on the draft EIS. Comments on the draft EIS and the staff's responses are provided in Appendix E. This final EIS has change bars in the page margins to denote where information has been updated or added in response to public comment or where changes, other than minor editorial changes, have been made.

1.1.1.2 USACE Permit Application Review

The USACE is part of the review team that makes a determination based on the three significance levels established by the NRC; however, the USACE's independent Record of Decision regarding the aforementioned permit application will reference the analyses in the EIS and present any additional information required by the USACE to support its permit decision. The USACE's role as a cooperating agency in the preparation of this EIS is to ensure that the information presented in the EIS is adequate to fulfill the requirements of USACE regulations and the EPA's 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material found at 40 CFR Part 230 (hereafter the 404(b)(1) Guidelines) to construct the preferred alternative identified in the EIS. The EIS is intended to provide the environmental information the USACE needs to meet its NEPA obligation, complete its review, and draw conclusions regarding the least environmentally damaging practicable alternative (LEDPA), public good, and the Public Interest Review Factors (PIRFs) for its permitting decision.

In this EIS, the USACE evaluates certain construction and maintenance activities proposed in waters of the United States, including wetlands that would be affected by the proposed project. The USACE decision will reflect the national concern for both protection and use of important resources. The benefit that may reasonably be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments.

The decision whether to issue a permit will be based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activity, and its intended effect on the public interest. This evaluation requires a careful weighing of all of the factors that become relevant in each particular case. A decision by the USACE to authorize this proposal, and if so, the conditions under which it will be allowed to occur, are therefore determined by the outcome of this general balancing process. All factors that may be relevant to the proposal must be considered, including the cumulative effects thereof. The USACE PIRFs are listed and described more fully in Appendix I.

For activities involving discharges regulated by Section 404 of the Clean Water Act, a permit will be denied if the discharge would not comply with the EPA's 404(b)(1) Guidelines. Subject to the aforementioned guidelines and any other applicable guidelines and criteria (see 33 CFR 320.2 and 320.3), a permit will be granted unless the USACE district engineer determines that it would be contrary to the public interest. The following general criteria are considered in the evaluation of every application:

- the relative extent of the public and private need for the proposed structure or work
- where there are unresolved conflicts about resource use, the practicability of using practicable and reasonable alternative locations and methods to accomplish the objective of the proposed structure or work
- the extent and permanence of the beneficial and/or detrimental effects that the proposed structure or work is likely to have on the public and private uses to which the area is suited.

1.1.2 Preconstruction Activities

In a final rule dated October 9, 2007, "Limited Work Authorization for Nuclear Power Plants" (72 FR 57416), the Commission limited the definition of "construction" to those activities within its regulatory purview as defined in 10 CFR 51.4. Many of the activities required to construct a nuclear power plant are not part of the NRC's regulatory authority. Activities associated with building the plant that are not within the purview of the NRC action are grouped under the term "preconstruction." Preconstruction activities include clearing and grading, excavating, erecting support buildings and transmission lines, and other associated activities. These preconstruction activities may occur before the application for a COL is submitted, during the review of a COL application, after a COL is granted, or in some cases, concurrently with NRC-regulated construction. Although preconstruction activities are outside the NRC's regulatory authority, many of them are within the regulatory authority of local, State, or other Federal agencies, including certain preconstruction activities that require permits from the USACE.

Because preconstruction activities are not part of the NRC action, their impacts are not reviewed as a direct effect of the NRC action. Rather, the impacts of preconstruction activities are considered in the context of cumulative impacts. In addition, certain preconstruction activities that propose to discharge dredged, excavated, and/or fill material into waters of the United States, including jurisdictional wetlands that require permits from the USACE, are viewed by that agency as direct effects related to its Federal permitting action. Jurisdictional wetlands are wetlands as defined in the Clean Water Act Section 404(b)(1) Guidelines. Chapter 4 of this EIS describes the relative magnitude of impacts related to preconstruction and construction activities.

1.1.3 Cooperating Agencies

NEPA lays the groundwork for coordination between the lead agency preparing an EIS and other Federal agencies that may have jurisdiction by law or special expertise regarding an environmental issue. These other agencies are referred to as “cooperating agencies.” Cooperating agencies have the responsibility to assist the lead agency through early participation in the NEPA process, including scoping, by providing technical input to the environmental analysis and making staff support available as needed by the lead agency.

Where impacts are proposed to waters of the United States, proposed nuclear power plants require a permit from the USACE in addition to a license from the NRC. Therefore, the NRC and the USACE concluded that the most effective and efficient use of Federal resources in the review of nuclear power projects would be achieved by a cooperative agreement. On September 12, 2008, the NRC and the USACE signed a Memorandum of Understanding regarding the review of nuclear power plant license applications (USACE and NRC 2008). Therefore, the Charleston District of the USACE is a cooperating agency as defined in 10 CFR 51.14. The USACE request for cooperation on the environmental review for Lee Nuclear Station was received by the NRC on February 16, 2009 (USACE 2009a) and accepted on March 30, 2009 (NRC 2009a).

As described in the Memorandum of Understanding, the NRC is the lead Federal agency, and the USACE is a cooperating agency in the development of the EIS. Under Federal law, each agency has jurisdiction related to portions of the proposed project. The goal of this cooperative agreement is the development of a single EIS that serves the needs of both the NRC license decision process and the USACE permit decision process. While both agencies must comply with NEPA, the NRC and the USACE have additional mission requirements that must be met. The NRC makes license decisions under the Atomic Energy Act (42 U.S.C. 2011 et seq.), and the USACE makes permit decisions under the Clean Water Act. The USACE is cooperating with the NRC to ensure that the information presented in the NEPA documentation is adequate to fulfill the requirements of USACE regulations; the EPA’s Clean Water Act Section 404(b)(1) Guidelines (40 CFR Part 230), which contain the substantive environmental criteria used by the USACE in evaluating discharges of dredged or fill material into waters of the United States; and the USACE public interest review process.

As a cooperating agency, the USACE is part of the NRC review team and has been involved in all aspects of the environmental review, including scoping, public meetings, public comment resolution, and EIS preparation. The USACE refers to public meetings as hearings; however, no adjudicatory process is involved as in NRC hearings conducted by the Atomic Safety and Licensing Board. For the purposes of assessing environmental impacts under NEPA, the EIS uses the SMALL/MODERATE/LARGE criteria discussed in Section 1.1.1.1; this approach has been vetted by the Council on Environmental Quality. However, for permit decisions under Section 404 of the Clean Water Act, the USACE can only permit the LEDPA and must address PIRFs. This EIS is intended to provide information about the environmental impacts necessary to allow the USACE to address the public interest in the Record of Decision associated with the permit decision. However, some of the PIRFs not specifically related to environmental impact, such as mineral needs, are not addressed in this EIS.

The timing of the preparation of the EIS compared to the timing of the USACE permit review is such that the USACE will not have completed its assessment of the LEDPA criterion until it receives public feedback in the form of public comments on the draft EIS. The USACE will address whether the LEDPA criterion is met in the Record of Decision. The goal of the process is for the USACE to have all of the information necessary to make a permit decision when the final EIS is issued. However, it is possible that the USACE will still need some information from Duke to complete the permit documentation—information that Duke may not make available by the time of final EIS issuance. In addition, any conditions required by the USACE, such as compensatory mitigation, will be addressed in the permit issued by the USACE. Mitigation is an important aspect of the review and balancing process for many Department of the Army permit applications. Consideration of mitigation will occur throughout the permit application review process and includes avoiding, minimizing, rectifying, reducing, or compensating for resource losses. Losses will be avoided to the extent practicable. Compensation may occur onsite or at an offsite location.

1.1.4 Participating Agencies

The proposed location of the intake and discharge structures, and the source of cooling water and the recipient of effluent, for the proposed Lee Nuclear Station Units 1 and 2 is the Ninety-Nine Islands Reservoir, which is a feature of the Ninety-Nine Islands Hydroelectric Project, operated by Duke and regulated by the Federal Energy Regulatory Commission (FERC). Under the hydroelectric project license issued by the FERC, Duke is required, in part, to request authorization for any water intake or pumping facilities that extract more than one million gallons of water per day from the project reservoir. To protect and enhance the scenic, recreational, fish and wildlife, and other environmental values of the hydroelectric project, upon receipt of an application, the FERC must review Duke's water withdrawal/discharge proposal and accompanying construction activities for the Lee Nuclear Station that occur within the hydroelectric project boundary. Duke expects to apply for necessary FERC permits in 2013.

To enhance interagency coordination and ensure that issues of concern are identified, the FERC requested to be a participating agency in the environmental review of Duke's combined license application for the Lee Nuclear Station (FERC 2011a). As a participating agency, the FERC provided input at key decision points during the NEPA evaluation process, in particular on those environmental areas that also fall under its jurisdiction.

1.1.5 Concurrent NRC Reviews

In reviews separate from, but parallel to, the EIS process, the NRC analyzes the safety characteristics of the proposed site and emergency planning information. These analyses are documented in a Safety Evaluation Report (SER) issued by the NRC. The SER presents conclusions reached by the NRC regarding (1) whether there is reasonable assurance that two Westinghouse AP1000 reactors can be constructed and operated at the Lee Nuclear Station site without being inimical to the common defense and security or to the health and safety of the public; (2) whether the emergency preparedness program meets the applicable requirements in 10 CFR Part 50, 10 CFR Part 52, 10 CFR Part 73, and 10 CFR Part 100; and (3) whether site characteristics are such that adequate security plans and measures can be developed. The final SER for the Duke COL application is expected to be published as a NUREG document in 2015. Part 2 of Duke's COL application is the Final Safety Analysis Report (FSAR), which is updated annually. Revision 7 of the FSAR was published on May 9, 2013 (Duke 2013a).

Since submission of the Lee Nuclear Station COL application, Westinghouse has updated its design certification application with Revisions 18 and 19 (Westinghouse 2010a, 2011) of the AP1000 design control document. The reactor design referenced in Duke's COL application is Revision 19 of the AP1000 certified design (Westinghouse 2011). The final rulemaking for Revision 19 of the AP1000 design was published on December 30, 2011 (76 FR 82079).

1.2 The Proposed Federal Actions

The proposed NRC Federal action is issuance, under the provisions of 10 CFR Part 52, of COLs for authorizing the construction and operation of two new AP1000 reactors at the Lee Nuclear Station site. The proposed USACE Federal action is issuance of a permit pursuant to Section 404 of the Clean Water Act authorizing certain activities potentially affecting waters of the United States based on evaluation of the probable impacts, including cumulative impacts, of the proposed construction activities on the public interest.

This EIS provides the NRC and the USACE analyses of the environmental impacts that could result from building and operating two proposed units at the Lee Nuclear Station or one of the three alternative sites. These impacts are analyzed by the review team to determine whether the preferred site is suitable for the construction and operation of the units and whether any alternative site is considered obviously superior to the proposed site.

1.3 Purpose and Need for the Proposed Actions

The purpose and need for the proposed actions are described below.

1.3.1 The NRC's Proposed Action

In its 2011 and 2012 analyses (Duke 2011g, 2012a), Duke indicated that a combination of additional baseload, intermediate and peaking generation, renewable resources, and energy efficiency and demand-side management programs are required over the next 20 years, specifying a need for approximately 4440 MW(e) of additional capacity by 2027 (Duke 2012a). Accordingly, the purpose and need for the proposed NRC action (i.e., issuance of COLs) is to provide additional baseload electrical generating capacity in 2024 and 26[a] within the service territories of Duke (Duke 2013b). The need for additional baseload power is discussed in Chapter 8 of this EIS.

Two COLs from the NRC are needed to construct and operate two proposed AP1000 units at the Lee Nuclear Station site. Preconstruction and certain long lead-time activities, such as ordering and procuring certain components and materials necessary to construct the plant, may begin before the COLs are granted. Duke must obtain and maintain permits or authorizations from other Federal, State, and local agencies and permitting authorities prior to undertaking certain activities. The ultimate decision whether to build the new units and the schedule for building are not within the purview of the NRC nor the USACE and would be determined by the license holder if the authorizations are granted.

1.3.2 The USACE's Permit Action

Duke's November 2011 permit application to the USACE is for work to prepare the site and facilities for two proposed new nuclear units at the Lee Nuclear Station site. Defining the project objectives is critical to the evaluation of any project and to evaluating compliance with the Clean Water Act Section 404(b)(1) Guidelines. In addition to the NEPA-required purpose and need described above, the 404(b)(1) Guidelines and subsequent 404(q) guidance require that the USACE define the "basic project purpose" and the "overall project purpose" to verify appropriate consideration of alternatives.

(a) On October 15, 2013, Duke submitted its 2013 Integrated Resource Plan (IRP) to the North Carolina Utilities Commission. In this document Duke modified the in-service dates for the two units to 2024 and 2026 and adjusted its projections for future generation sources. Because the review team determined that the changes in the updated IRP do not materially change the analysis or its results, the analysis that follows has not been modified to address the 2013 IRP.

The basic purpose is the most simple or irreducible objective of the project and is used to determine whether the applicant's project is "water-dependent" (40 CFR 230.10(a)(3)). The water dependency test contained in the 404(b)(1) Guidelines creates a presumption that activities that do not require access to, proximity to, or siting within special aquatic sites to fulfill their basic project purpose are not water-dependent. Therefore, the 404(b)(1) Guidelines state that practicable alternatives to non-water-dependent activities are presumed to exist, are less damaging, and are environmentally preferable to alternatives that involve discharges into special aquatic sites (e.g., wetlands and riffle and pool stream complexes) (40 CFR 230.10(a)(3)). The basic purpose of this project would be to generate electricity for additional baseload capacity. Constructing facilities to create energy supplies is not a water-dependent activity, and in accordance with the 404(b)(1) Guidelines, practicable alternatives that do not involve discharges into special aquatic sites are presumed to exist unless clearly demonstrated otherwise (40 CFR 230.10(a)(3)).

In addition to defining the basic project purpose, the USACE must also define the overall project purpose. The overall project purpose establishes the scope of the alternatives analysis and is used for evaluating practicable alternatives under the 404(b)(1) Guidelines. In accordance with the 404(b)(1) Guidelines and guidance from USACE Headquarters, the overall project purpose must be specific enough to define the applicant's needs, but not so narrow and restrictive as to preclude a proper evaluation of alternatives. The USACE is responsible for controlling every aspect of the 404(b)(1) Guidelines analysis (HQUSACE 1989). In this regard, defining the overall project purpose for issuance of Department of the Army permits is the sole responsibility of the USACE. While generally focusing on Duke's purpose and need statement, the USACE will, in all cases, exercise independent judgment in defining the purpose and need for the project from both Duke's and the public's perspectives (33 CFR Part 325; 53 FR 3120).

The overall purpose of the project would be to construct a power-generating facility to provide for additional baseload electrical generating capacity to meet the growing demand in the states of South Carolina and North Carolina.

1.4 Alternatives to the Proposed Actions

Section 102(2)(C)(iii) of NEPA states that EISs are to include a detailed statement analyzing alternatives to the proposed action. The NRC regulations for implementing Section 102(2) of NEPA provide for including in an EIS a chapter that discusses the environmental impacts of the proposed action and the alternatives (10 CFR Part 51, Subpart A, Appendix A). This EIS addresses five categories of alternatives: (1) the no-action alternative, (2) energy source alternatives, (3) alternative sites, (4) system design alternatives, and (5) onsite alternatives to reduce impacts on natural and cultural resources.

In the no-action alternative, the proposed action would not go forward. The NRC could deny Duke's request for the COLs. If the request was denied, the construction and operation of two new nuclear generating units at the Lee Nuclear Station site would not occur, nor would any benefits intended by the approved COLs be realized. The USACE could deny Duke's permit request. If the permit were denied, Duke's construction of the two new units would not go forward as proposed. Energy source alternatives include energy-replacement technologies such as oil-fired and gas-fired generation and wind power, focusing on alternatives that could generate baseload power and, therefore, could meet the purpose and need of the project. System design alternatives include heat-dissipation and circulating-water systems, intake and discharge structures, and water-use and water-treatment systems. Finally, onsite alternatives evaluated by the USACE to reduce impacts to waters of the United States, including jurisdictional wetlands and shoreline resources, are described.

In the ER, Duke defines a region of interest for use in identifying and evaluating potential sites for power generation (Duke 2009c). Using the process outlined in the ER, Duke reviewed multiple sites and identified a suite of candidate sites for this power generation project. The alternative sites include the Perkins site in North Carolina and the Keowee and Middleton Shoals sites in South Carolina. Duke owns the Perkins and Keowee sites. All three sites are greenfield sites; however, Keowee is on the eastern border of the existing Oconee Nuclear Power Plant site. In this EIS the review team evaluates the region of interest, the process by which Duke selected alternative sites, and the environmental impacts of construction and operation of two new nuclear reactors at those sites using reconnaissance level information. The objective of the comparison of environmental impacts is to determine if any of the alternative sites are environmentally preferable and, if so, whether any are obviously superior to the preferred Lee Nuclear Station site.

As part of the evaluation of permit applications subject to Section 404 of the Clean Water Act, the USACE is required by regulation to apply the criteria set forth in the 404(b)(1) guidelines (33 U.S.C. 1344; 40 CFR Part 230). These guidelines establish criteria that must be met for the proposed activities to be permitted pursuant to Section 404. Specifically, these guidelines state, in part, that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impacts on the aquatic ecosystem provided the alternative does not have other significant adverse consequences (40 CFR 230.10(a)). An area not presently owned by the applicant that could reasonably be obtained, used, expanded, or managed to fulfill the basic purpose of the proposed activity may be considered if it is otherwise a practicable alternative.

1.5 Compliance and Consultations

Before constructing and operating the two proposed units, Duke is required to obtain certain Federal, State, and local environmental permits, as well as meet applicable statutory and regulatory requirements. In the ER (Duke 2009c), Duke provided a list of environmental approvals and consultations associated with proposed Lee Nuclear Station Units 1 and 2. Duke provided an update to this list in March 2013 (Duke 2013c). Potential authorizations and consultations relevant to the proposed COL are included in Appendix H of this EIS. The information provided in Appendix H is based on ESRP guidance (NRC 2000a). The review team reviewed the list and has contacted the appropriate Federal, State, Tribal, and local agencies to identify any compliance, permit, or significant environmental issues of concern to the reviewing agencies that may affect the acceptability of the Lee Nuclear Station site for building and operating the proposed two Westinghouse AP1000 PWRs. A chronology of all environmental review correspondence is provided as Appendix C. A list of the key Federal, State, and Tribal consultation correspondence is provided as Appendix F.

1.6 Report Contents

Subsequent chapters of this EIS are organized as follows. Chapter 2 describes the proposed site and discusses the environment that would be affected by the proposed nuclear reactor units. Chapter 3 describes the power plant layout, structures, and activities related to building and operation that are used as the basis for evaluating the environmental impacts. Chapters 4 and 5 examine the environmental impacts of building (Chapter 4) and operating (Chapter 5) the proposed nuclear reactor units. Chapter 6 analyzes the environmental impacts of the uranium fuel cycle, transportation of radioactive materials, and decommissioning. Chapter 7 examines the cumulative impacts of the proposed action as defined in 40 CFR Part 1508. Chapter 8 addresses the need for power. Chapter 9 discusses alternatives to the proposed action; analyzes alternative energy sources, sites, and system designs; and compares the proposed action with these alternatives. Chapter 10 summarizes the findings of the preceding chapters, provides a benefit-cost evaluation, and presents the NRC staff's recommendation with respect to the Commission's approval of the proposed site for COLs based on the evaluation of environmental impacts.

The appendices to the EIS provide the following additional information:

- Appendix A – Contributors to the Environmental Impact Statement
- Appendix B – Organizations Contacted
- Appendix C – NRC and USACE Environmental Review Correspondence
- Appendix D – Scoping Comments and Responses

- Appendix E – Draft Environmental Impact Statement Comments and Responses
- Appendix F – Key Consultation Correspondence
- Appendix G – Supporting Documentation on Radiological Dose Assessment and Historic and Cultural Resources
- Appendix H – Authorizations, Permits, and Certifications
- Appendix I – U.S. Army Corps of Engineers Public Interest Review Factors
- Appendix J – Carbon Dioxide Footprint Estimates for a 1000-MW(e) Reference Reactor

2.0 Affected Environment

The site proposed by Duke Energy Carolinas, LLC (Duke) for two combined construction permits and operating licenses (combined licenses or COLs) and a Department of the Army permit is located in the eastern portion of Cherokee County in north-central South Carolina. The proposed William States Lee III Nuclear Station (Lee Nuclear Station) site property is owned by Duke and is the site of the former Duke Power Company Cherokee Nuclear Station. Development of the former Cherokee Nuclear Station was halted mid-construction in the early 1980s. The location of the proposed Lee Nuclear Station is described in Section 2.1, with the land use, water use and quality, ecology, socioeconomics, environmental justice, historic and cultural resources, geology, meteorology and air quality, the nonradiological environment, and the radiological environment of the site presented in Sections 2.2 through 2.11, respectively. Section 2.12 examines related Federal projects and consultations.

2.1 Site Location

Figure 2-1 shows Duke's proposed location for Lee Nuclear Station in relationship to the counties and important cities and towns within a 50-mi radius. The nearest population centers with more than 25,000 residents are Charlotte, North Carolina, 40 mi to the northeast; Spartanburg, South Carolina, 25 mi to the southwest; and Greenville, South Carolina, 52 mi to the southwest. The nearest population center is Gastonia, North Carolina, located approximately 24 mi to the northeast of the site. The closest community is Gaffney, South Carolina, the county seat of Cherokee County, located approximately 8.2 mi to the northwest (Duke 2009c). The Universal Transverse Mercator grid coordinates (NAD83) in meters (m) for the center line between the proposed Units 1 and 2 are 453,331 m east and 3,877,239 m north (Duke 2013c).

Figure 2-2 shows the vicinity (within a 6-mi radius) of the Lee Nuclear Station site. The site occupies approximately 1900 ac along the west side of the Broad River (Duke 2009c). At the southeastern edge of the property is Ninety-Nine Islands Dam that impounds the Broad River to create Ninety-Nine Islands Reservoir. The site is generally bounded by Ninety-Nine Islands Reservoir to the north and east, McKowns Mountain Road to the south, and private property to the west and part of the south. McKowns Mountain Road is the primary access route to the site. An abandoned railroad spur enters the northern side of the property and ends near the middle of the site. Figure 2-3 shows the planned footprint of major structures at the Lee Nuclear Station site, along with the site's placement along the Broad River and the location of Ninety-Nine Islands Dam.

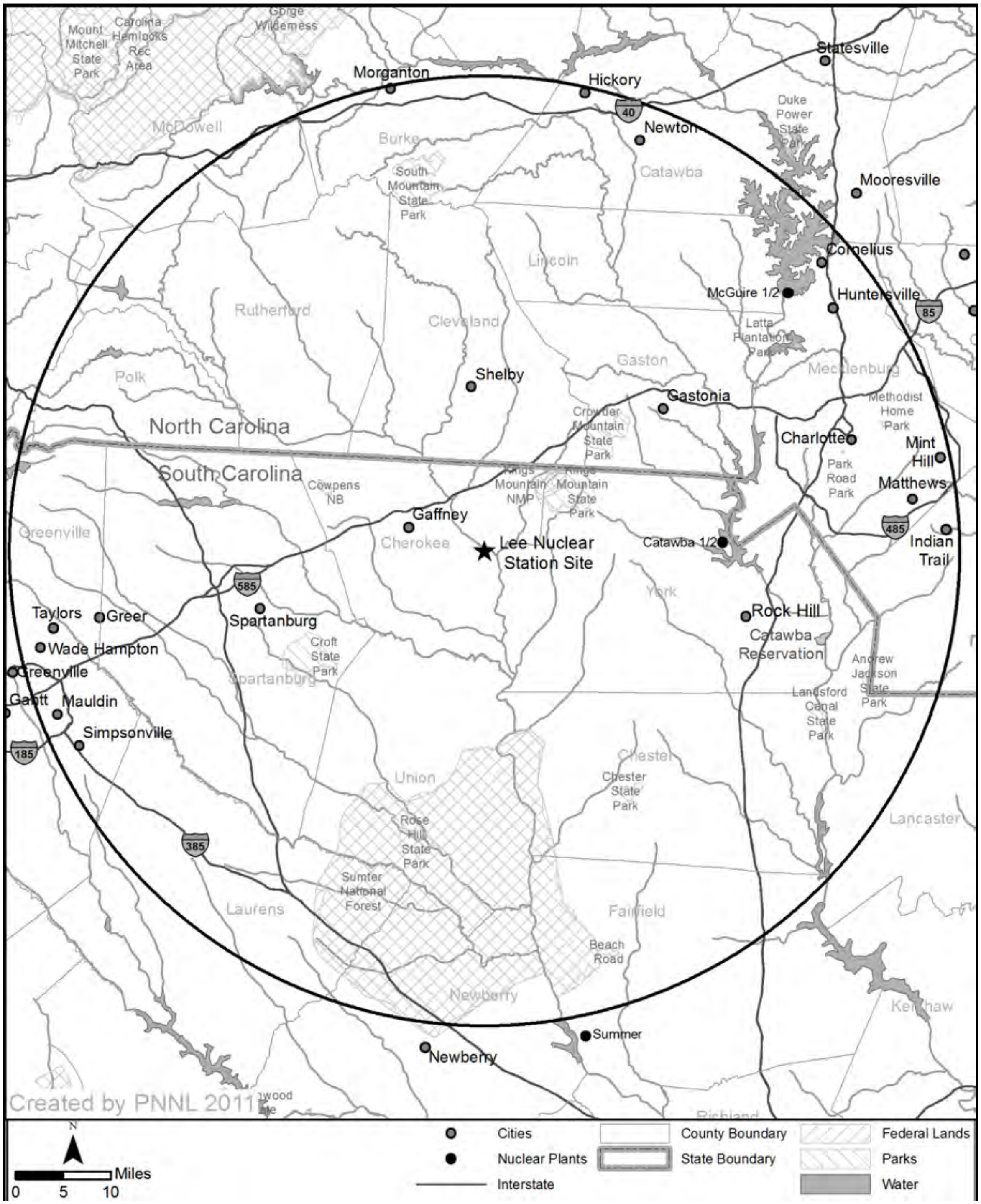

Figure 2-1. Area within a 50-Mi Radius of the Proposed Lee Nuclear Station

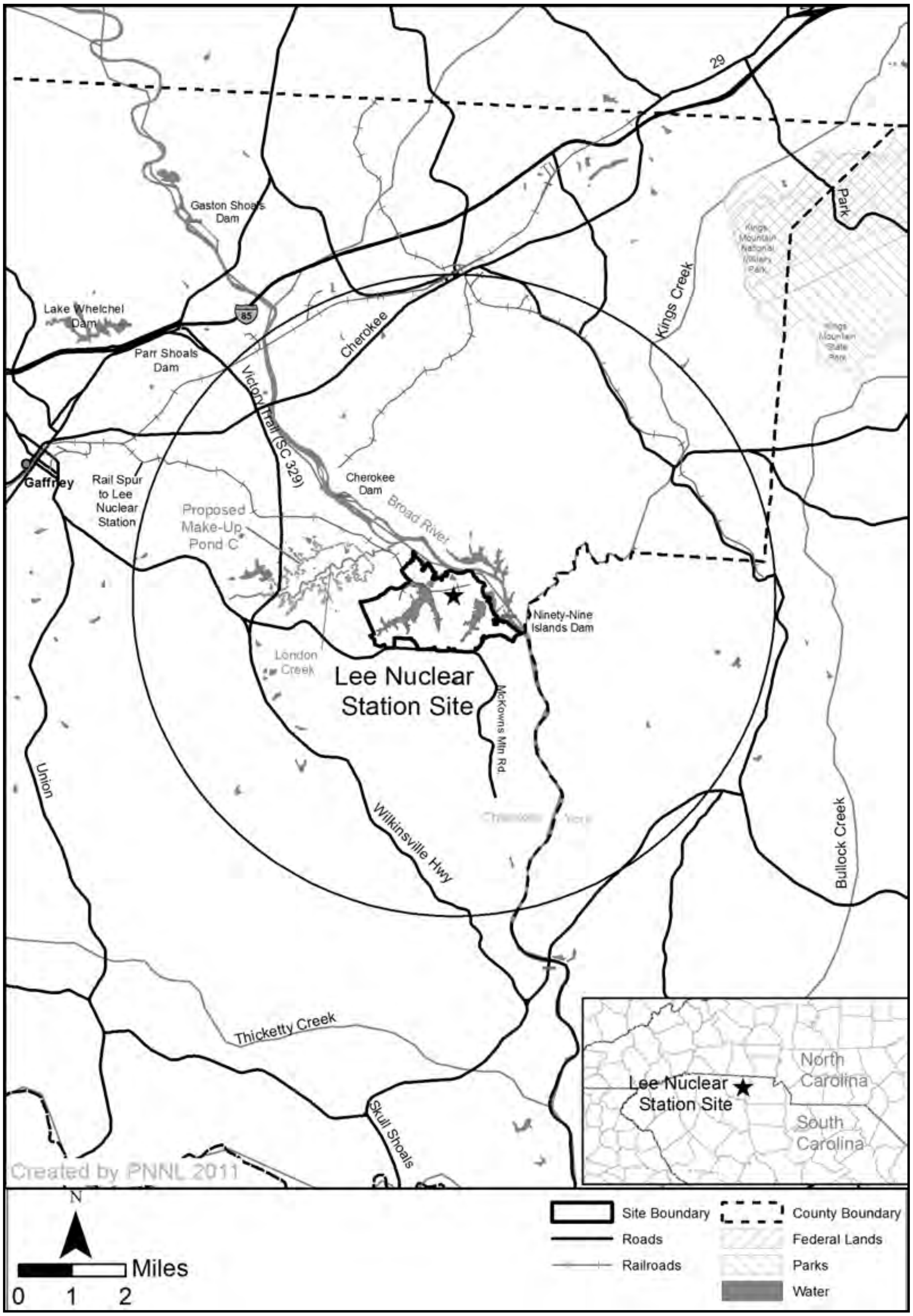

Figure 2-2. 6-Mi Vicinity of the Lee Nuclear Station Site

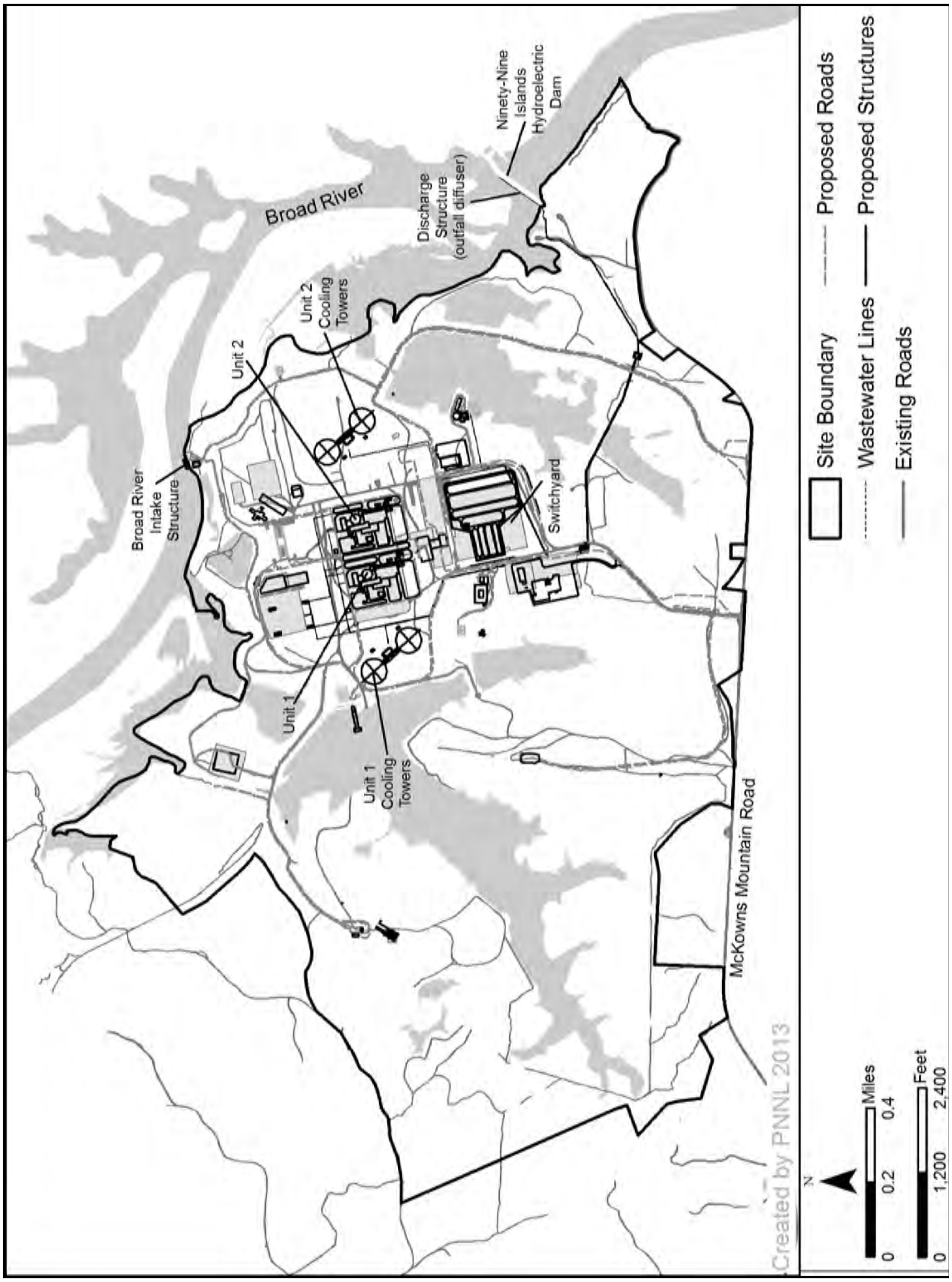

Figure 2-3. Planned Footprint of Major Structures at the Proposed Lee Nuclear Station

2.2 Land Use

This section discusses land use for the proposed Lee Nuclear Station. Section 2.2.1 describes the site and the vicinity within a 6-mi radius of the site (Figure 2-2). Section 2.2.2 describes the proposed Make-Up Pond C site. Section 2.2.3 discusses the proposed transmission corridors and other offsite facilities. Section 2.2.4 discusses the region, defined as the area within 50 mi of the center point of the proposed Lee Nuclear Station power block footprint (Figure 2-1).

2.2.1 The Site and Vicinity

The Lee Nuclear Station site refers to an area of 1928 ac in an unincorporated portion of Cherokee County, South Carolina (Duke 2013d). The 6-mi vicinity also includes a portion of York County, South Carolina. The proposed site lies within the existing boundaries of the unfinished Cherokee Nuclear Station site, and is wholly owned by Duke (Duke 2009c).

The Lee Nuclear Station site is situated on the south bank of the Broad River, immediately to the west of Ninety-Nine Islands Dam. The Broad River from Ninety-Nine Islands Dam south to the confluence with the Pacolet River (15.3 mi) was designated as a State Scenic River in 1991. With that designation, the Broad River became part of the South Carolina Scenic Rivers Act of 1989 (South Carolina Code, Title 49, Chapter 29), the purpose of which is to protect unique and outstanding river resources throughout South Carolina. However, the reach adjoining the Lee Nuclear Station site is upstream of the dam and hence without this designation. The Broad River is not classified as a National Wild and Scenic River as the term is defined in Title 36 of the *Code of Federal Regulations* (CFR) 297.3. There are no additional publically accessible waterbodies within the Lee Nuclear Station site boundary (Duke 2009c). The site and vicinity are not located within the coastal zone.

The proposed location for the Lee Nuclear Station site is an abandoned industrial construction site that was evaluated by the U.S. Nuclear Regulatory Commission (NRC) in the mid-1970s, and where construction permits were issued for three nuclear reactor units (unfinished Cherokee Nuclear Station) (NRC 1975a). Construction activities began in 1977 and were halted in 1982 and 1983 (NRC 2012a), resulting in alterations to the site. During that time, approximately 750 ac of land were disturbed by site-preparation, excavation, and other initial site-development activities (Duke 2009c). In 1986, the site was purchased by Earl Owensby Studios for production of a movie, after which the site sat idle until it was purchased by Cherokee Falls Development Company, LLC in 2005. Duke purchased all outstanding ownership shares in early 2007 (Duke 2009c).

Within the proposed site boundaries, previous construction activities—including excavation and site development—left numerous changes to the land, some of which remain. Several structures present at the site when Duke wrote the initial version of the environmental report (ER) in 2007 have since been removed, including the partially constructed power unit buildings and several large and small buildings that were used in support of previous construction activities. Still present are several large excavated areas, including several small impoundments, material laydown areas, and buildings—including a guardhouse. Concrete pads and vehicle parking areas are present at several locations on the site. A system of paved roads links existing development features on the site, while peripheral areas are served by a related system of unpaved roads (Duke 2009c).

Utilities that originally served the unfinished Cherokee Nuclear Station include buried utility pipelines, overhead electric distribution lines, and communication lines. These utilities are still present at the Lee Nuclear Station site (Duke 2009c).

An abandoned railroad spur enters the Lee Nuclear Station site and extends across the northern half of the site, terminating at the previously excavated area where the new power block would be built. The abandoned spur connects the Lee Nuclear Station site to the main railroad line operated by Norfolk Southern that runs through Gaffney, South Carolina, and connects to Blacksburg, South Carolina (Duke 2009c).

The Lee Nuclear Station site contains three major surface-water impoundments excavated prior to 1982 to provide cooling water to the Cherokee Nuclear Station reactors that were never built. The impoundments are designated Make-Up Pond A on the east side of the site, Make-Up Pond B on the west side of the site, and Hold-Up Pond A on the north end of the site. Make-Up Pond B was originally formed by the impoundment of McKowns Creek (Duke 2009c). Make-Up Ponds A and B and Hold-Up Pond A are jurisdictional waters of the United States (under the jurisdiction of the U.S. Army Corps of Engineers [USACE]) (USACE 2007a). The USACE has also identified 12.52 ac of wetlands and several open water areas and streams onsite that are under jurisdiction of the Clean Water Act (USACE 2013a). In addition, 100-year floodplains occur in low-lying areas of the Lee Nuclear Station site, primarily along the Broad River and around the margins of Make-Up Ponds A and B (USACE 2013a).

The land cover within the Lee Nuclear Station site boundary, as described by Duke (2009c) using the U.S. Geological Survey (USGS) 2001 National Land Cover Dataset, is primarily upland forest (i.e., 64 percent made up of deciduous, evergreen, and mixed forest), with most of the remainder classified as grassland, pasture, and developed land. Previously excavated areas, including water impoundments, are classified as water. Developed land cover within the vicinity is approximately 8 percent (Table 2-1) and limited primarily to areas near East Gaffney and Blacksburg, South Carolina. Table 2-1 provides a summary of land-cover statistics for the site, vicinity, and region.

Table 2-1. Land Cover Near the Lee Nuclear Station Site

USGS Description	Percentage of Site	Area (ac)	Percentage of Vicinity (6-mi)	Area (ac)	Percentage of Region (50-mi)	Area (ac)
Water	14.5	279	1.4	1446	1.5	73,132
Open developed	2.6	49.4	5.6	5891	9.3	461,912
Low-intensity developed	0.4	8.0	2.2	2276	4.5	221,711
Medium-intensity developed	0	0	0.3	346	1.2	62,067
High-intensity developed	0	0	0.2	161	0.6	31,240
Barren land	0.1	2.7	0.04	40	0.6	32,075
Deciduous forest	50.8	979	45.1	47,088	34.7	1,725,013
Evergreen forest	7	135	15.9	16,630	17.8	887,107
Mixed forest	2.9	55.7	2.5	2602	1.5	74,612
Shrub/scrub	2.6	50.4	2.8	2918	1.2	58,241
Grassland	15.5	299.3	7.8	8159	5.9	291,133
Pasture	3.1	59.2	15.3	16,010	19.3	961,495
Cropland	0.3	5.5	0.3	279	0.3	13,607
Woody wetlands	0.2	4.3	0.5	502	1.6	78,191
Emergent herbaceous wetlands	0	0.5	0.01	12	0	301
Total	**100**	**1928**	**100**	**104,360**	**100**	**4,971,837**

Source: Adapted from Duke 2009c. Site data is scaled to a site area of 1928 ac (Duke 2013d)

Even though no zoning laws currently apply to the Lee Nuclear Station site in this unincorporated portion of Cherokee County, South Carolina, Duke maintains a land-management plan for the Lee Nuclear Station site. Since 2005, Duke has maintained pumps to remove seepage water from previously excavated areas (Duke 2009c). As indicated by the U.S. Department of Agriculture (USDA 2002) soil survey database, approximately 2 ac of prime farmland are present in the southeast corner of the proposed site, but these 2 ac are not currently farmed. Prime farmland is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is available for these uses, or under defined conditions would be available for these uses (7 CFR Part 657). Although Duke owns the mineral rights on the Lee Nuclear Station site, no known mineral resources within or adjacent to the site are being exploited, nor are there any known mineral resources of value. However, an active sand-mining operation adjacent to the Broad River is situated approximately 1 mi upstream (Duke 2009c).

Topography in the vicinity of the Lee Nuclear Station site consists of rolling, forested woodland hills with elevations ranging from approximately 511 ft above mean sea level (MSL) on the shore of Ninety-Nine Islands Reservoir to 816 ft above MSL at the top of McKowns Mountain. There are several homes and small farms within the vicinity of the site; these residences are predominantly south of the McKowns Mountain Road and to the west of the site (Duke 2009c).

The Lee Nuclear Station site is accessible only by the McKowns Mountain Road, which runs along most of the southern boundary of the site. South Carolina Route 105 (SC 105; Wilkinsville Highway) runs from Gaffney and eventually turns into McKowns Mountain Road approximately 4 mi to the west of the site entrance. Victory Trail Road (SC 329) intersects McKowns Mountain Road (state roadway) at this same location, and intersects Federal Highway 29 approximately 4 mi to the north.

The closest communities to the Lee Nuclear Station site include Gaffney, East Gaffney, Blacksburg, Hickory Grove, and Smyrna. Gaffney, with 12,492 residents, has the largest population near the Lee Nuclear Station site (USCB 2010e). The city is located approximately 8.2 mi northwest of the site and has the closest hospital to the site (Duke 2009c). East Gaffney has a population of 2784 and is located approximately 7.5 mi to the northwest of the site. Blacksburg has a population of 2007 and is located approximately 5.8 mi to the north of the site (USCB 2010e). The nearest residences are located immediately to the south of the site boundary, along McKowns Mountain Road. The nearest school is Draytonville Elementary, approximately 4 mi west of the site. The nearest church is McKowns Mountain Baptist Church, near the entrance to the site on McKowns Mountain Road (Duke 2009c).

The vicinity includes all land within a 6-mi radius of the Lee Nuclear Station site and includes local parks and recreational facilities (Figure 2-2). The nearest State park is Kings Mountain State Park located approximately 7.8 mi northeast of the site; this park shares its northern boundary with Kings Mountain National Military Park. Kings Mountain State Park is 6885 ac, and offers fishing, boating, equestrian facilities, camping, and hiking. Kings Mountain National Military Park is nearly 4000 ac, and offers back country hiking, equestrian facilities, camping, and historical references through short-film presentations and a museum. Gaffney has seven local parks and a golf course, all located within 10 mi of the site. Additionally, there are two campgrounds near the Lee Nuclear Station site; one at Kings Mountain, and the other at Pinecone Campground, which is 5 mi west of Gaffney. The State-designated Broad Scenic River offers paddling, bird watching, picnicking, fishing, and other outdoor activities (Duke 2009c).

Cherokee County contains 14 reservoirs and one lake, all of which may be used for recreational purposes (Duke 2009c). Recreational access points for Ninety-Nine Islands Reservoir include the Cherokee Ford Recreation Area near Goat Island; Pick Hill boat access north of Ninety-Nine Islands Dam on the east bank of the Broad River accessible from SC 43; and the area to the immediate south of the dam (also on the east bank) that offers canoe portage, a tailrace fishing area, and a boat ramp. Lake Cherokee is a public waterbody, located approximately 2 mi west of the western site boundary. Figure 2-2 provides a detailed view of the proposed Lee Nuclear Station vicinity, which includes roads and waterways.

2.2.2 The Make-Up Pond C Site

Make-Up Pond C is proposed for the purpose of allowing operation of the proposed Lee Nuclear Station during severe drought conditions. The total proposed Make-Up Pond C site encompasses approximately 2110 ac and is located northwest of the Lee Nuclear Station in the London Creek watershed (Duke 2009b). When acquired by Duke, the proposed Make-Up Pond C site consisted mostly of forest and pasture land interspersed with small areas of grassland, residential and other development, scrub, cropland, water, and wetlands (Table 2-2 and Figure 2-4). The USACE has identified 7.43 ac of wetlands and several open waters and streams on the site that are subject to its jurisdiction under the Clean Water Act (USACE 2013a) (Section 2.4). In addition, 100-year floodplains occur in low-lying areas of the site, primarily in low areas along London Creek (Section 2.4.1). The Make-Up Pond C site contains approximately 260 ac of land designated as prime farmland and farmland of statewide importance (Duke 2009b). The entire Make-Up Pond C site lies within an unincorporated area of Cherokee County and, therefore, is not subject to zoning restrictions. The Make-Up Pond C site lies upstream of the Ninety-Nine Islands Dam and does not abut the portion of the Broad River designated as a State Scenic River.

Table 2-2. Land-Cover Classification for the Make-Up Pond C Site

Land-Cover Classification	Area (ac)	Percentage of Area
Forested (deciduous, evergreen, and mixed forest)	1372	65.0
Pasture land	443	21.0
Residential development	11	0.5
Grassland	114	5.4
Open development	82	3.9
Shrub/scrub	53	2.5
Cropland	27	1.3
Water	6	0.3
Woody wetlands	2	<0.1
Total	**2110**	**100**

Source: Adapted from Duke 2009b

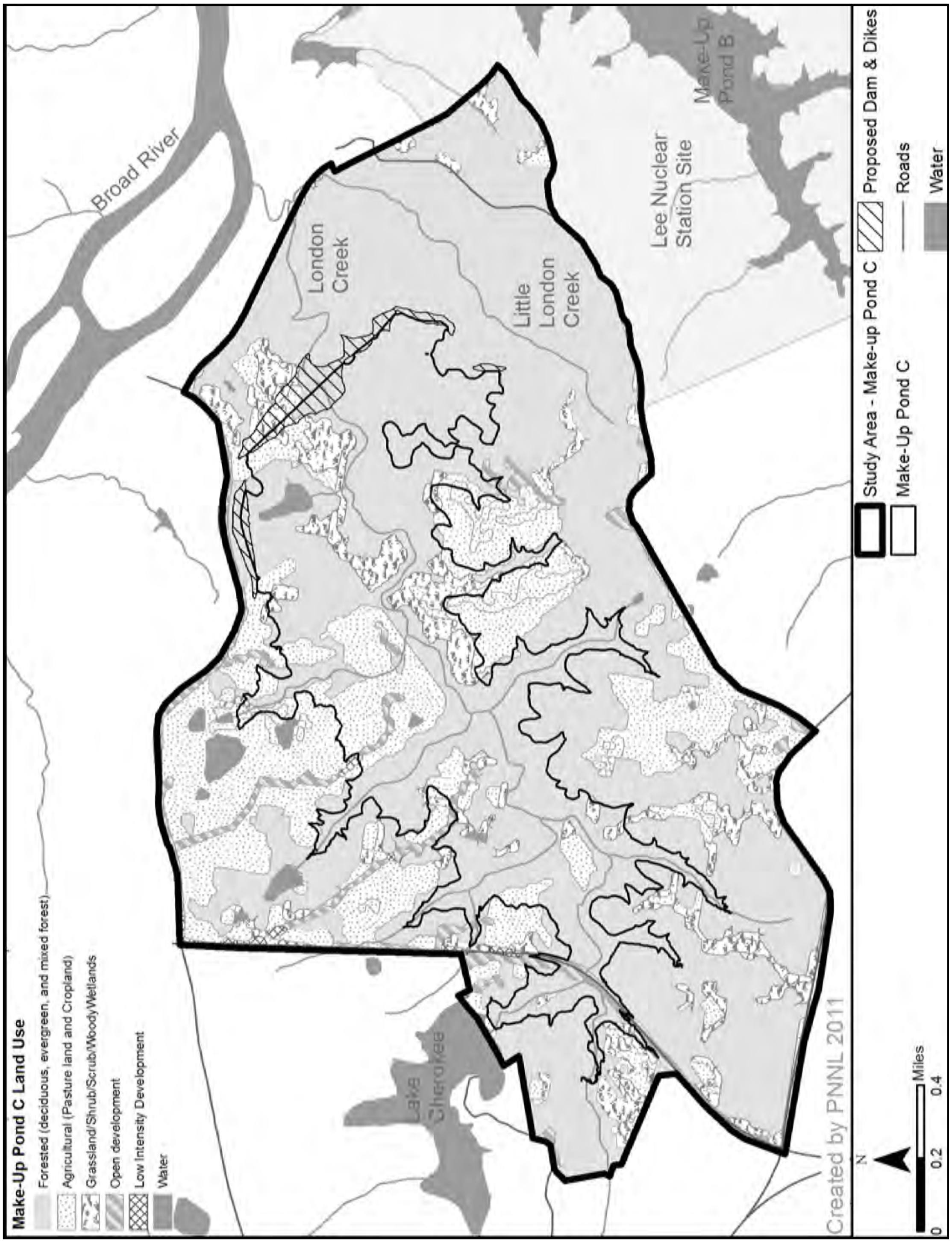

Figure 2-4. Make-Up Pond C Land Cover

According to Duke (2013d), Make-Up Pond C itself, including the impoundment, dam footprint, saddle dikes, and spillway, would occupy approximately 643 ac. The land needed for other elements of Make-Up Pond C, including spoils placement areas, vegetation maintenance areas, and various roads, transmission lines, and ancillary facilities to support the pond, would include an additional area of about 404 ac, for a total footprint of approximately 1047 ac. The remaining acreage on the Make-Up Pond C site would be owned and managed by Duke; however, Duke has not decided how it would use those lands not permanently occupied by Make-Up Pond C or its ancillary facilities. The rural landscape surrounding the Make-Up Pond C site contains scattered areas of residential development. Residences are located east of SC 329 (Victory Trail Road), off of Edward Road, Darby Road, Old Barn Road, Grace Road, Jimmy Road, and Whites Road. Other residential development is located north of Rolling Mill Road off of Deer Ridge Road, Fawn Trail, and Buck Trail (Duke 2009b). Approximately 86 privately owned housing units (single-family houses and mobile units) have been removed from the Make-Up Pond C site since Duke acquired the land (Duke 2012b).

2.2.3 Transmission-Line Corridors and Other Offsite Facilities

Section 2.2.3.1 discusses the proposed offsite transmission-line corridors and Section 2.2.3.2 discusses the proposed offsite railroad-spur route.

2.2.3.1 Transmission-Line Corridors

Duke is proposing to add 2234 MW(e) capacity to the existing transmission systems serving the region. Duke is therefore proposing to establish two additional transmission-line corridors, termed Route K and Route O, that would each contain two transmission lines (one 230 kV and one 525 kV). Duke would reroute existing lines through the proposed new Lee Nuclear Station switchyard. Duke conducted a comprehensive siting and environmental analysis to select routes for the proposed new transmission corridors that minimize effects to land use, environmental resources, cultural resources, and aesthetic quality (Duke 2007c).

At the proposed Lee Nuclear Station and the Make-Up Pond C site, the proposed transmission-line corridors would lie within the Piedmont physiographic region in an area composed of gently rolling hills with limited changes in the overall elevation. The total geographic area evaluated by Duke (2007c) for the new transmission-line corridors was approximately 181,420 ac, of which approximately 121,600 ac are mapped as forest or woodlands. From 21 alternative routes, representing 115 different route combinations, 2 corridors were selected as meeting the criteria that would minimize effects to land use, environmental resources, cultural resources, and aesthetic quality. The two selected corridors encompass approximately 987 ac; almost all of which (i.e., 97 percent) are not subject to zoning restrictions and consist mostly of forest and pasture land. None of the proposed transmission lines would cross the Broad River, which is considered a state scenic waterway from Ninety-Nine Islands Dam to the confluence of the Pacolet River (Duke 2007c). None of the proposed transmission-line routes are located within the coastal zone.

Approximately 163 ac of the proposed transmission-line corridors are considered prime farmland, or farmland of statewide importance (Duke 2007c). In addition to land Federally designated as prime farmland, farmland of statewide importance has been designated by individual State and County agricultural boards as being especially important to food crop production regionally (7 CFR Part 657). Duke permits farming and crop production within transmission-line corridors and expects these uses only to be limited where the new transmission-line structures would be located (Duke 2009c). Approximately 66 ac of transmission-line corridor is within the 100-year floodplain (Duke 2007c). The corridors also encompass streams, open waters, and approximately 11.17 ac of jurisdictional wetlands (USACE 2013a) (Section 2.4). Table 2-3 provides current land-cover characterization within the proposed corridors.

Table 2-3. Proposed Transmission-Line Corridor Land Cover Classification

Land-Cover Classification	**Route K (ac)**	**Route O (ac)**	**Total Area (ac)**
Bottomland/floodplain forest	21.2	6.7	27.9
Closed canopy evergreen forest/woodland	128.9	50.7	179.6
Cultivated land	0	0	0
Dry deciduous forest/woodland	0.4	1.5	1.9
Dry scrub/shrub thicket	48.2	38.8	87.0
Fresh water	10.0	5.2	15.2
Grassland/pasture	90.4	86.3	176.7
Marsh/emergent wetland	0	0	0
Mesic deciduous forest/woodland	60.9	90.0	150.9
Mesic mixed forest/woodland	159.7	154.9	314.6
Needle-leaved evergreen mixed forest/woodland	10.7	4.6	15.3
Open canopy/recently cleared forest	0	0	0
Urban development	12.2	5.0	17.2
Urban residential	0	0	0
Wet scrub/shrub thicket	0.3	0.1	0.4
Total	**543.0**	**443.8**	**986.8**

Source: Duke 2007c

The proposed transmission system supporting Lee Nuclear Station Units 1 and 2 would be tied into the existing Oconee-Newport 525-kV line and the Pacolet-Catawba 230-kV transmission lines in two corridors that would run south and southwest of the Lee Nuclear Station site. From the proposed switchyard at the Lee Nuclear Station site, each transmission-line corridor would carry one 525-kV line and one 230-kV line to their respective tie-in locations with the existing transmission lines (Duke 2007c). By distributing both voltage and tie-in locations, Duke is not anticipating the need for additional transmission lines to provide offsite power to the Lee Nuclear Station site in case of an emergency.

From the Lee Nuclear Station site switchyard, two new transmission-line corridors have been identified. They are labeled Route K, which runs generally south and west of the Lee Nuclear Station site, and Route O, which runs generally south of the Lee Nuclear Station site. Corridors exiting from the Lee Nuclear Station site switchyard have a 325-ft right-of-way (ROW) and would support both a 230-kV line and a 525-kV line to the first tie-in location on the 230-kV Pacolet-Catawba transmission line. Each corridor from the Pacolet-Catawba line to the Oconee-Newport 525-kV tie-in location would have a 200-ft ROW and would support one 525-kV line (Duke 2007c). The proposed new corridors and tie-in locations to the existing transmission-line corridors in the vicinity of the Lee Nuclear Station site are shown in Figure 2-5.

The Route K transmission-line corridor runs generally southwest from the Lee Nuclear Station site switchyard to the Pacolet-Catawba 230-kV tie-in location. It then runs generally south to the Oconee-Newport 525-kV tie-in location. The entire length of the corridor is approximately 17.5 mi. The length from the Lee Nuclear Station site switchyard to the first tie-in location on the Pacolet-Catawba 230-kV transmission line is approximately 8.0 mi. The corridor from the Pacolet-Catawba 230-kV line to the Oconee-Newport 525-kV tie-in location is approximately 9.5 mi (Duke 2007c).

The Route O transmission-line corridor runs generally south from the Lee Nuclear Station site following the boundary between Cherokee and York Counties. The entire length is approximately 13.9 mi. The length from the Lee Nuclear Station site to the first tie-in location on the Pacolet-Catawba 230-kV transmission line is approximately 7.1 mi. The length from the Pacolet-Catawba 230-kV line to the Oconee-Newport 525-kV transmission-line tie-in location is approximately 6.8 mi (Duke 2007c).

With the exception of areas around Smyrna, Hickory Grove, and Sharon, South Carolina, the proposed transmission-line corridors would run through predominantly rural areas.

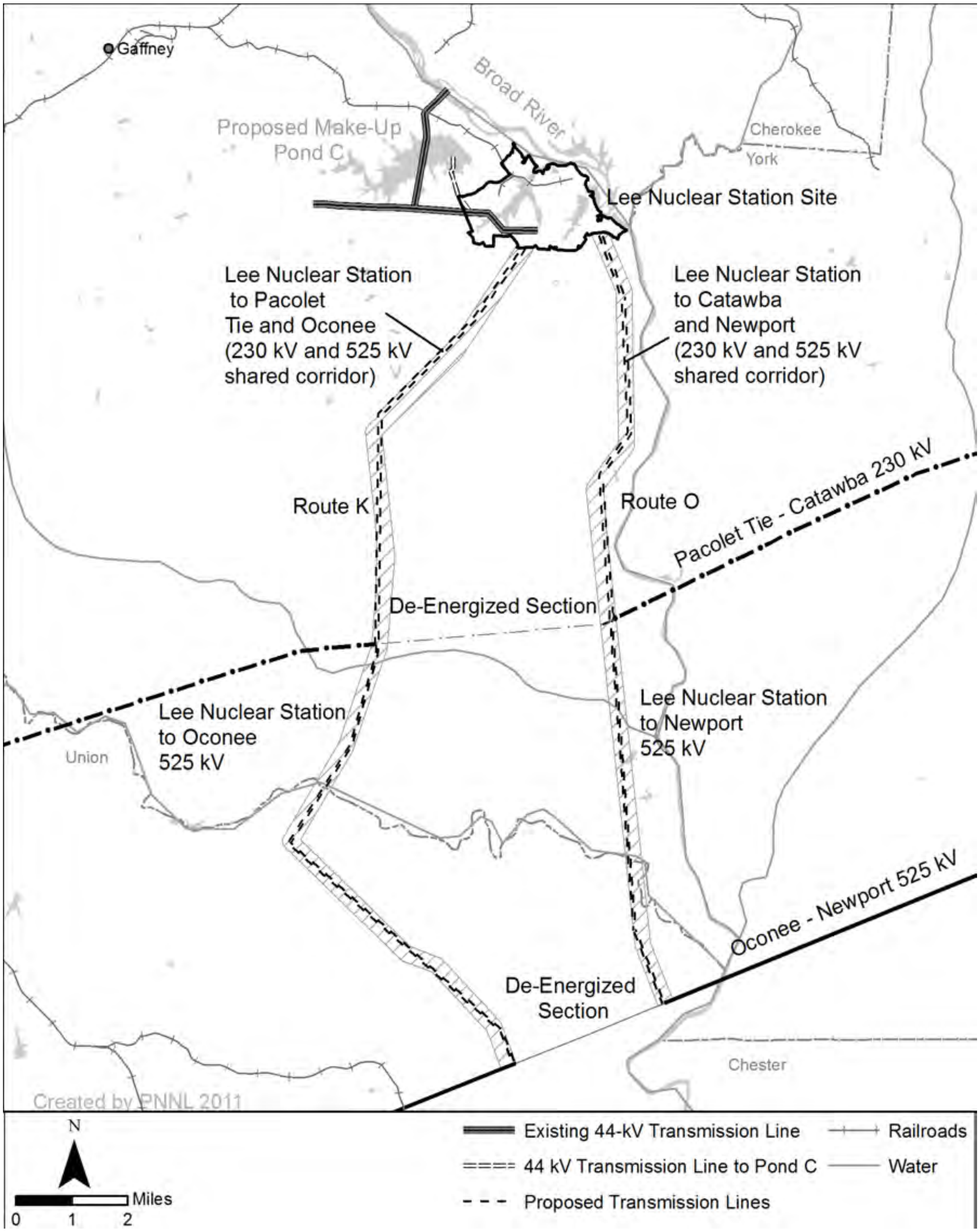

Figure 2-5. Existing and Proposed Electrical Transmission Systems

2.2.3.2 Railroad Corridor

The 6.8-mi-long and 50-ft-wide corridor for the railroad spur from near Gaffney to the Lee Nuclear Station site was abandoned when the Cherokee Nuclear Station project was cancelled in 1982. After the project was terminated, the rails were removed and the ROW reverted to private ownership. Duke is reacquiring the necessary ROW and would reactivate the railroad spur by installing new ballast and track for the construction of Lee Nuclear Station Units 1 and 2. The original study area for the railroad corridor extended 25 ft on both sides of the bottom of the 50-ft-wide berm of the rail embankment, creating a 100-ft-wide study area along the corridor (Enercon 2008). Duke also plans a short detour from the original ROW where it is occupied by Reddy Ice on the southeast edge of East Gaffney (Figure 2-6). The detour involves approximately 1300 ft of track with a 50-ft-wide ROW (Duke 2009c).

2.2.4 The Region

The region, defined as 50 mi beyond the Lee Nuclear Station site, includes all or portions of the following counties in South Carolina: Cherokee, Chester, Fairfield, Greenville, Lancaster, Laurens, Newberry, Spartanburg, Union, and York; and in North Carolina, Burke, Cabarrus, Catawba, Cleveland, Gaston, Henderson, Iredell, Lincoln, McDowell, Mecklenburg, Polk, Rutherford, and Union. Major waterways, highways, parks, and recreational areas in the region are shown in Figure 2-1, which also includes the transmission-line corridors study area.

There are several large cities within the region (Figure 2-1). The Lee Nuclear Station site is approximately 40 mi southwest of Charlotte, North Carolina (population 704,422) and 25 mi northeast of Spartanburg, South Carolina (population 40,387). Interstate-85 (I-85) passes 8 mi to the northwest of the site. South Carolina State Routes SC 5, SC 97, and SC 118 are within 6 mi of the east boundary of the site and SC 18 passes approximately 6 mi from the west boundary of the site.

Land use within the region varies with distance from major population centers and high-use corridors. The metropolitan areas of Charlotte, Gastonia, and Spartanburg contain the highest density of residential, commercial, and light industrial land uses. Land cover in the immediate vicinity of the Lee Nuclear Station site and the areas outside the noted metropolitan areas and transportation corridors are primarily forest (54 percent), pasture (19 percent), and grassland (6 percent) (Table 2-1). Cropland is less than 1 percent within the region (Duke 2009c).

The region surrounding the Lee Nuclear Station site contains Federal lands including Cowpens National Battlefield to the northwest, Sumter National Forest to the south, and the Kings Mountain National Military Park to the east. Tribal lands of Federally recognized Native American Tribes within the region include the Catawba Indian Reservation, situated approximately 31 mi east-southeast of the Lee Nuclear Station site (Duke 2009c).

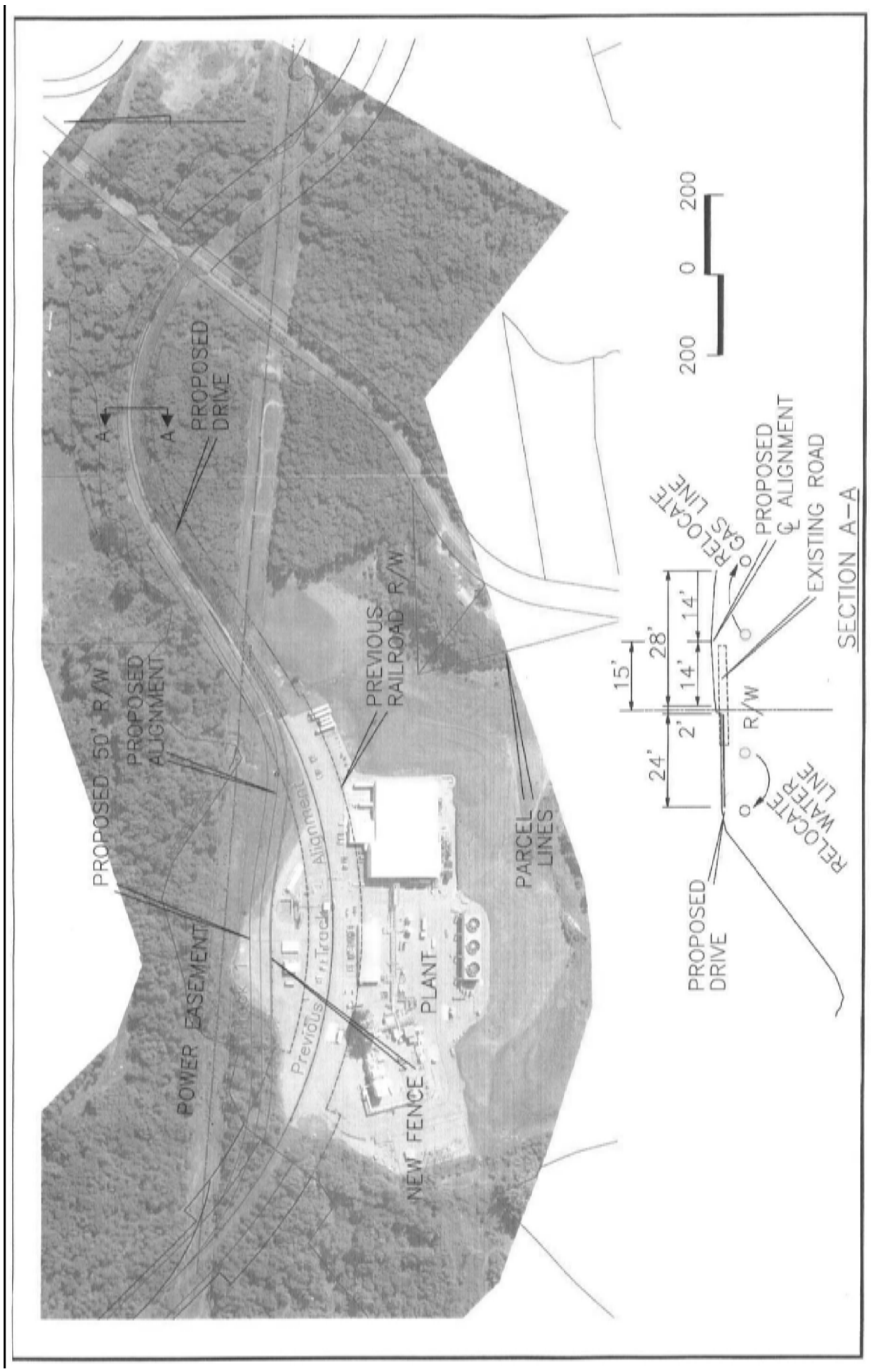

Figure 2-6. Proposed Railroad-Spur Detour

Three airports with regularly scheduled passenger air service reside within the region: Charlotte Douglas International Airport is 34 mi to the northeast, Hickory Regional Airport is 47 mi to the northeast, and Greenville-Spartanburg International Airport is 41 mi to the southwest. There are also several smaller municipal airports, including Spartanburg and Lincoln, and numerous agricultural-use airstrips scattered throughout the region (Duke 2009c).

2.3 Water

This section describes the hydrological processes governing movement and distribution of water in the existing environment at the Lee Nuclear Station site. The surface waterbodies, groundwater resources, existing water uses, and water quality in the vicinity of the site are described.

2.3.1 Hydrology

This section describes the site-specific and regional hydrological features that could be altered by construction and operation of the proposed Lee Nuclear Station Units 1 and 2 and by creating proposed Make-Up Pond C in the London Creek drainage northwest of the site. The hydrological features of the site and vicinity are presented in Section 2.3 of the ER (Revision 1) and the Make-Up Pond C supplement to the ER (Duke 2009b, c). Duke described the hydrological features of the site related to site safety (e.g., probable maximum flood) in the Final Safety Analysis Report (FSAR) portion (Part 2) of its COL application (Duke 2013a). All elevations in this section are given in feet above MSL unless otherwise stated. It is assumed that elevations reported in the ER have adopted the same convention when no vertical datum is otherwise referenced.

The Lee Nuclear Station site lies in the Broad River basin in the Piedmont physiographic region of South Carolina. As described in Section 2.1, the 1900-ac (3-mi^2) site is located southwest of the Broad River, 0.5 mi upstream of Ninety-Nine Islands Dam in Cherokee County, South Carolina (Figure 2-2). Elevations across the site range from approximately 512 ft at the Broad River to 816 ft at the top of McKowns Mountain, with the higher elevations to the west and lower elevations to the east (Duke 2009c). Lee Nuclear Station Units 1 and 2 would have a proposed final site grade of 593 ft (Duke 2013a).

London Creek is a tributary to the Broad River located just upstream and to the northwest of the Lee Nuclear Station site (Figure 2-7). It flows approximately 3.76 mi from the outflow of Lake Cherokee to its confluence with the Broad River (USACE 2013a); its drainage basin has a high elevation of 740 ft and a low elevation of about 520 ft at the Broad River. Duke proposes to dam approximately 3.16 mi of London Creek below Lake Cherokee to form Make-Up Pond C, a 620-ac impoundment designed to provide supplemental water to proposed Lee Nuclear Station Units 1 and 2 during periods of prolonged low flow in the Broad River (USACE 2013a).

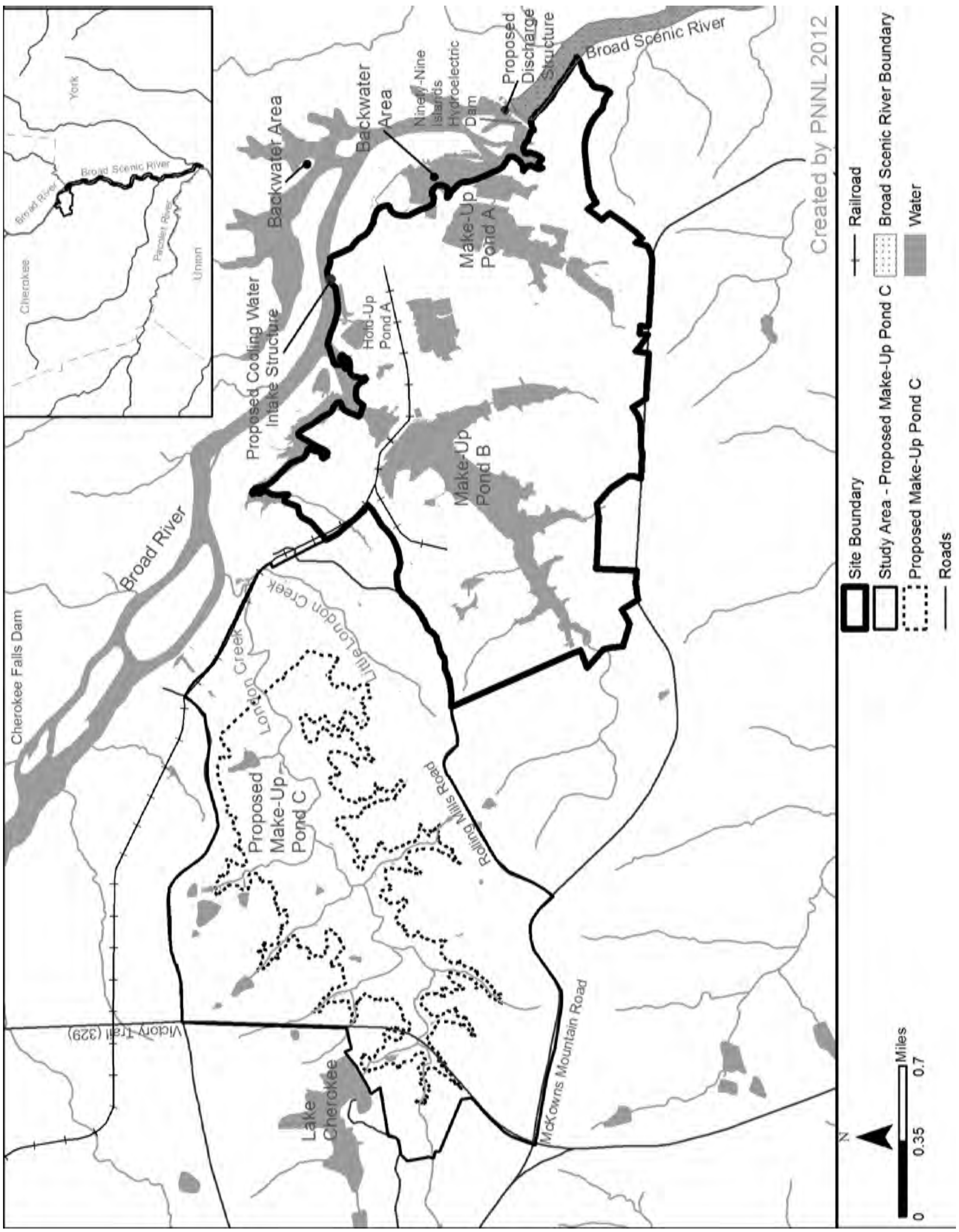

Figure 2-7. Waterbodies On and Near the Lee Nuclear Station Site

2.3.1.1 Surface-Water Hydrology

This section provides physical information needed to support the water-related assessment of surface-water including hydrological alteration, water use, water quality, aquatic ecology, radiological transport, and socioeconomic impacts.

Broad River

Surface-water in the vicinity of the Lee Nuclear Station site is dominated by the Broad River and onsite impoundments formed by damming local tributaries. The Broad River originates in the Blue Ridge Mountains in North Carolina, and flows southeast through the foothills and the Piedmont before its confluence with the Saluda River in Columbia, South Carolina, to form the Congaree River. These rivers are part of the larger Santee River Basin (USGS hydrologic unit code 030501). The upper and lower Broad River basins and other major watersheds within the Santee River Basin are shown in Figure 2-8 (Duke 2009c).

The drainage area of the Broad River above Ninety-Nine Islands Dam is approximately 1550 mi^2, consisting of the Upper Broad River (drainage area 184 mi^2) and four major tributaries: the Green River (137 mi^2), Second Broad River (513 mi^2), First Broad River (426 mi^2), and Buffalo Creek (163 mi^2) (Duke 2009c). Lower Buffalo Creek, Cherokee Creek, and other direct drainages make up another 130 mi^2 of drainage area. These drainage areas are shown in Figure 2-9, as are major dams and bridges in the upper Broad River basin.

Ninety-Nine Islands Reservoir, adjacent to the Lee Nuclear Station site, is a “run-of-the-river” impoundment of the Broad River formed by Ninety-Nine Islands Dam. Ninety-Nine Islands Reservoir and other onsite impoundments are described later in this section. Two other Broad River dams are in the vicinity of Lee Nuclear Station. Cherokee Falls Dam is 4.5 mi upstream of Ninety-Nine Islands Dam, and Gaston Shoals Dam is approximately 6 mi upstream of Cherokee Falls Dam. Like Ninety-Nine Islands Dam, both Cherokee Falls Dam and Gaston Shoals Dam were built for hydroelectric power (not flood control), and have run-of-the river reservoirs with no significant storage capacity. Further upstream in the Broad River basin there are over 100 dams, of which the two largest dams (Kings Mountain Lake and Lake Lure dams) represent approximately 64 percent of the Broad River basin storage capacity (Duke 2009c).

The streamflow in the Broad River has seasonal patterns typical of the southeastern United States. Flows generally mirror the pattern of precipitation, with higher flows in December through May and lower flows June through November. Flow fluctuations in the Broad River at the Lee Nuclear Station site would also be affected by the storage capacity of, and regulated releases from, upstream reservoirs. Streamflow data for the Upper Broad River is compiled by the USGS; gaging stations in the vicinity of the Lee Nuclear Station site and their characteristics are provided in Table 2-4. The nearest stream gaging station to the Lee Nuclear Station site is located on the Broad River just below Ninety-Nine Islands Reservoir (left bank of tailrace, 0.1 mi

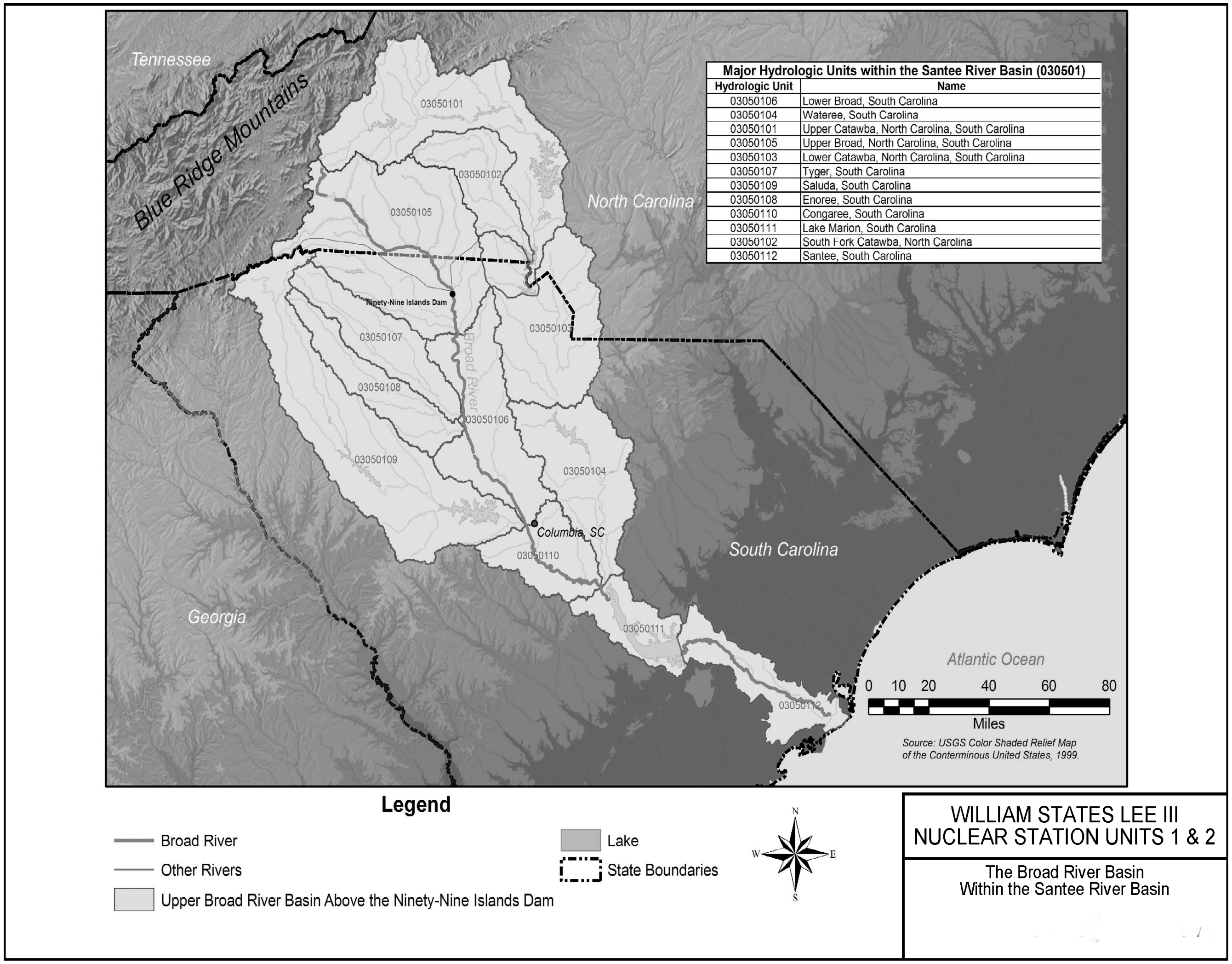

Figure 2-8. Upper and Lower Broad River Basins and Other Major Watersheds of the Santee River Basin (Duke 2009c)

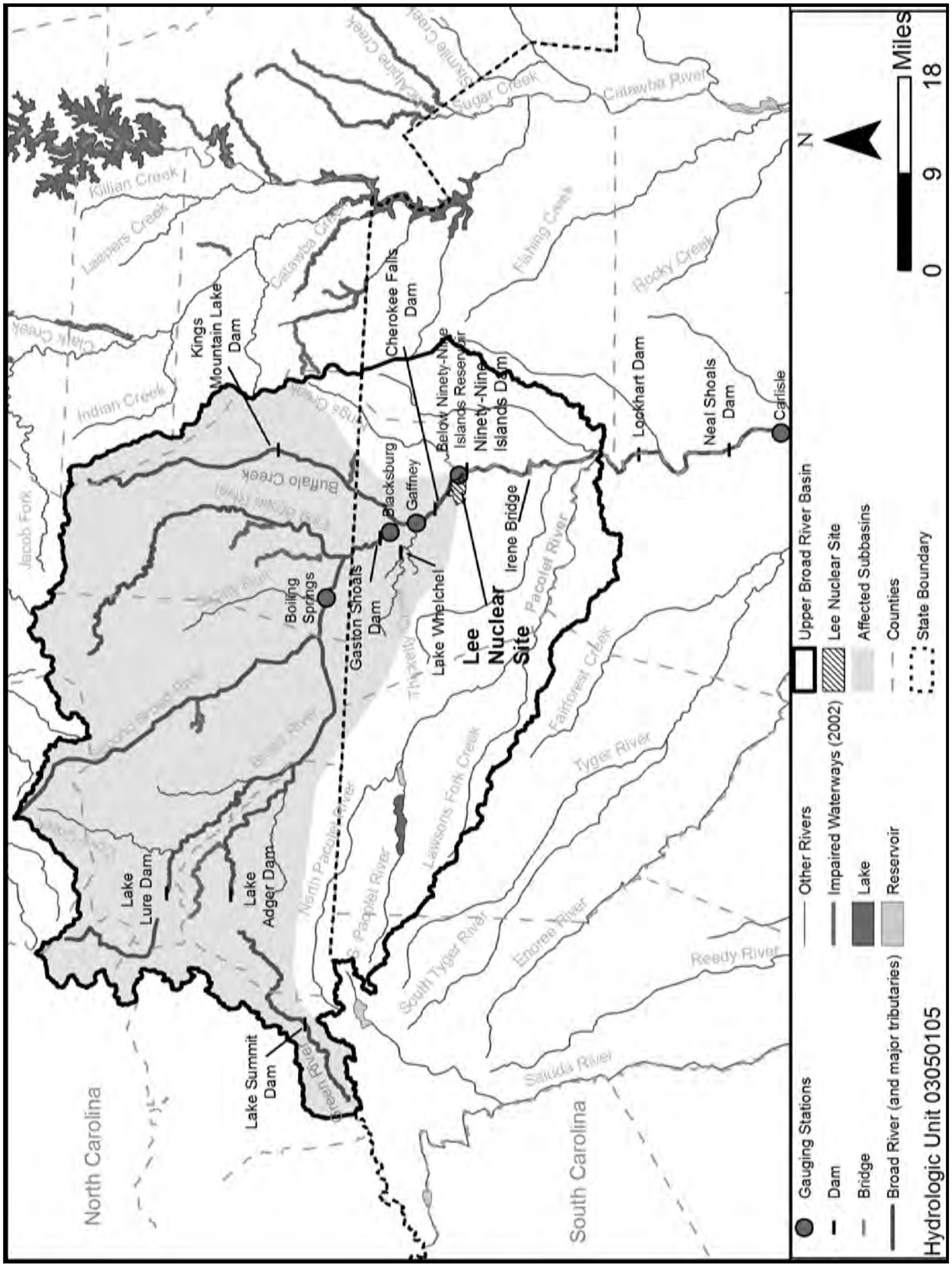

Figure 2-9. Upper Broad River Sub-Basins, Dams, and Gaging Stations

Table 2-4. USGS Monitoring Stations in the Vicinity of Lee Nuclear Station

USGS Gage	Description	Drainage Area (mi^2)	Period of Record for Discharge
02151500	Broad River near Boiling Springs, North Carolina	875	07/01/1925 to present
02153500	Broad River near Gaffney, South Carolina	1490	12/01/1938 to 09/30/1998
02153200	Broad River near Blacksburg, South Carolina	1290	09/24/1994 to present
02153551	Broad River below Ninety-Nine Islands Reservoir, South Carolina	1550	10/30/1998 to present[(a)]
02156500	Broad River near Carlisle, South Carolina	2790	10/01/1938 to present
02161000	Broad River at Alston, South Carolina	4790	10/01/1896 to present

Source: USGS 2010a, 2011b,c
(a) Prior to August 22, 2006, gage elevation was 412 ft NGVD29; present location is 700 ft downstream at elevation of 405 ft NGVD29.

upstream of Kings Creek) (USGS 2011a). The highest and lowest average monthly flows recorded by the USGS at this station were 8733 (April 2003) and 242 cfs (August 2002), respectively (USGS 2010a). During droughts, low flows can show considerable persistence. For instance, in the entire period from April 2007 through March 2009, the median monthly flow was exceeded for only one month (USGS 2010a, 2011a). Water years 2003 and 2008 have the highest and lowest annual mean flows of 4200 and 774 cfs, respectively. Based on the daily data for the same USGS gage for water years 2000 through 2010, the mean annual flow of the Broad River below Ninety-Nine Islands Reservoir is 1858 cfs and exceeds 467 cfs 90 percent of the time (USGS 2010a).

The USGS gage below Ninety-Nine Islands Dam has only operated since October 1998. Duke used data from the USGS gage near Gaffney, located approximately 8 mi upstream of the gage below Ninety-Nine Islands Dam, to construct a long-term flow record covering 85 years (1926-2010). Where gaps existed in the Gaffney record, flow estimates for Gaffney were calculated by pro-rating flows from the next gage upstream with available data (usually the USGS gage at Blacksburg, otherwise the USGS gage at Boiling Springs), based on the drainage area for that gage relative to the Gaffney Station drainage area (see Table 2-4) (Duke 2008a, 2009c). Using protocols consistent with USGS recommendations, Duke estimated a mean annual daily flow of 2495 cfs for the entire 85-year period of record and a mean annual daily flow of 1956 cfs for the most recent 10 years of record (2001 through 2010) at the Gaffney gage. Duke estimated a 7-day, consecutive low flow with a 10-year return frequency (7Q10) of 464 cfs (Duke 2011a).

The review team independently developed a synthetic, gap-filled streamflow record for the Broad River for the period July 1, 1925 to February 8, 2011 at the Lee Nuclear Station site. The review team's synthetic streamflow record was based on the USGS daily streamflow data using a combination of data from three gages and watershed proportionality. The review team's derived average flow was 2485 cfs.

The review team's estimate of mean annual flow (2485 cfs), Duke's estimate of mean annual flow (2495 cfs), and the USGS record of mean annual flow at the gage below Ninety-Nine Islands Dam (1858 cfs) are not inconsistent. The lower value for the USGS gage reflects the bias caused by a short period of record in which several severe droughts occurred. For the period 2001-2010, Duke reported a similar value (1956 cfs) to the USGS gage below Ninety-Nine Islands Dam (1858 cfs).

London Creek

London Creek is not gaged and there are no historical streamflow measurements, but Duke estimated London Creek flows by using a ratio of London Creek drainage area above the proposed dam location to the drainage area of Cove Creek near Lake Lure, North Carolina (USGS gage 02149000). The range of daily flows at the proposed dam location was estimated to be from near zero to a maximum of 213 cfs, with an average daily flow of approximately 7 cfs (Duke 2009b).

Vegetated areas experience evapotranspiration and other areas experience evaporation. These two hydrological processes transfer water from surface-water and groundwater to the atmosphere. The evaporation rate at any time is dependent on a variety of factors (e.g., humidity, air temperature, water temperature, and wind speed). Clemson University has measured and recorded 60 years of pan evaporation (Purvis 2011). The average pan evaporation for Clemson is 55 in./yr. This pan evaporation rate corrected to actual evaporation is 39 in./yr. The average annual evapotranspiration for the period from 1948 to 1990 in the vicinity of the Lee Nuclear Station site is estimated to be 30 in./yr (Cherry et al. 2001).

Impoundments

There are four impoundments on, or adjacent to, the Lee Nuclear Station site (Figure 2-7). Ninety-Nine Islands Reservoir, formed in 1910 by damming the Broad River for Ninety-Nine Islands Hydroelectric Project, is the largest of the impoundments. Ninety-Nine Islands Reservoir is the proposed source of cooling water for proposed Lee Nuclear Station Units 1 and 2. The reservoir characteristics, morphology, circulation, and mixing are described in Sections 2.3.1.3.1.1, 2.3.1.3.1.2, and 2.3.1.3.1.3 of the ER (Duke 2009c). Water flow through Ninety-Nine Islands Reservoir is dominated by the main channel of the Broad River, which separates two backwater areas formed by flooding side channels and small tributaries, one on each side of the river just above the dam (Figure 2-7). Evaporation and seepage are thought to be insignificant losses in terms of the water balance within Ninety-Nine Islands Reservoir because it is a run-of-the-river reservoir with estimated transit times of 3 hours at average flow (2500 cfs) and 16 hours at low flow (440 cfs), assuming a 570 ac-ft storage capacity in the main channel area and ignoring the backwater areas, which exhibit little circulation in nonflood periods (Duke 2009b).

Ninety-Nine Islands Reservoir is fairly shallow, so the impounded area and volume of the reservoir can change significantly with small fluctuations in reservoir level (Duke 2009c). In a September 2006 bathymetry study, Enercon (Duke 2008n) reported a maximum depth of 35.2 ft and a mean depth of 9.2 ft in a survey area that included both the Broad River main channel and backwater areas of Ninety-Nine Islands Reservoir. A more recent bathymetry study of Ninety-Nine Islands Reservoir conducted by Devine Tarbell & Associates (DTA) estimated a 351 ac surface area and 1684 ac-ft storage volume at full pond (DTA 2008a). The DTA study provides a table of projected area and volume changes with changes in water surface elevation (DTA 2008a).

Ninety-Nine Islands Reservoir and Ninety-Nine Islands Dam sustain Ninety-Nine Islands Hydroelectric Project, which is operated by Duke (Duke 2009c). Operations of Ninety-Nine Islands Hydroelectric Project and Ninety-Nine Islands Reservoir are regulated by the Federal Energy Regulatory Commission (FERC). The drawdown of Ninety-Nine Islands Reservoir is limited to 510 ft (1 ft below full impoundment level of 511 ft) from March to May and 509 ft (2 ft below full impoundment) for the remainder of the year, as permitted by the FERC operating license (Duke 2009c). At the 509-ft elevation, Ninety-Nine Islands Reservoir storage volume is estimated to be 1122 ac-ft (DTA 2008a). Article 402 of the FERC license for Ninety-Nine Islands Dam, issued June 17, 1996 and amended November 2011 (FERC 2011c), specifies continuous minimum flows for three periods: 966 cfs for January through April; 725 cfs for May, June, and December; and 483 cfs for July through November. It is unclear from Article 402 whether each of the three minimums or just the lowest minimum is the appropriate criteria to curtail withdrawals. The review team discussed the definition of minimum flows with FERC, (NRC 2012c). Uncertainty remained after these discussions as to the specific nature of the implementation of the low-flow limitations. In order to bracket the residual regulatory uncertainty from FERC, the review team decided to evaluate both seasonal low-flow limitations and a single low-flow limitation.

Ninety-Nine Islands Reservoir velocity distributions and bathymetry in the area affected by the Lee Nuclear Station intake structure are discussed in ER Section 2.3.1.2.1.3. The proposed location of the intake structure is on the shore of Ninety-Nine Islands Reservoir where the main channel of the Broad River is impounded by Ninety-Nine Islands Dam, approximately 1.5 mi upstream of the dam (Figure 2-7). The 2006 bathymetry survey shows a narrow scour channel in the vicinity of the proposed intake structure (Duke 2008n). The DTA (2008) bathymetry survey also shows deeper water at the proposed intake location. At the time of the 2006 bathymetry survey, Enercon (Duke 2008n) also measured river velocity at 5-ft depth intervals to 15 ft at seven stations along a cross-section of the Broad River at the intake structure location. The river is approximately 240 ft wide near the intake structure location. Enercon (Duke 2008n) measured velocities ranging from 0.24 to 0.40 ft/s, with an average of 0.32 ft/s.

The proposed location of the Lee Nuclear Station Units 1 and 2 discharge structure is on the upstream side of Ninety-Nine Islands Dam toward its northeast end, approximately 150 ft south of the intake for the hydroelectric powerhouse (Figure 2-7). Ninety-Nine Islands Reservoir velocity distributions and bathymetry in the area affected by the discharge structures were not characterized for the ER because of restricted access and safety issues related to hydroelectric operations (Duke 2009c). However, the Ninety-Nine Islands Reservoir survey conducted by DTA for Duke included bathymetric and water velocity data for Ninety-Nine Islands Reservoir immediately above the dam, and water elevation and velocity data for the tailrace below the dam (DTA 2008a). Velocities in the lower portion of the reservoir, just above the dam, ranged from zero to 1.72 ft /s when no hydroelectric units were operating and from zero to 2.34 ft/s when one hydroelectric unit was operating (DTA 2008a). In the immediate vicinity of the proposed outfall, velocities were generally in the 0.05 to 0.10 ft/s range when no units were operating and higher and more variable (generally 0.26 to 0.75 ft/s) when one hydroelectric unit was operating. USGS records indicate that Ninety-Nine Islands Reservoir was discharging approximately 500 cfs on the days of the survey (USGS 2011a).

The outfall diffuser for proposed Lee Nuclear Station Units 1 and 2 would release effluent on the upstream side of the dam and most of the effluent would flow into the hydroelectric powerhouse intake. DTA reported that water depth across most of the tailrace was less than 2 ft, with maximum depths of 5 ft when no hydroelectric units were operating and 6 ft when one hydroelectric unit was operating. Water velocities ranged from 0.01 to 3.9 ft/s, and were highest below the powerhouse (northeast end of the dam) and lower below the spillway and the southwest bank. No water was flowing over the spillway at the time of the survey (DTA 2008a).

Three impoundments are located on the Lee Nuclear Station site: Make-Up Pond A, Make-Up Pond B, and Hold-Up Pond A (Figure 2-7). The characteristics of these impoundments are shown in Table 2-5. These impoundments were created in the late 1970s during the initial construction phase of the unfinished Cherokee Nuclear Station.

Table 2-5. Characteristics of Surface-Water Impoundments on the Lee Nuclear Station Site

Impoundment[b]	Impounded Stream, (Watershed Area, mi^2)[a]	Normal Water Elevation (ft MSL)	Surface Area (ac)[b]	Mean Depth (ft)[b]	Total Storage (ac-ft)[b]
Make-Up Pond B	McKowns Creek (2.55)	570	154	31	3994
Make-Up Pond A	Arm of Ninety-Nine Islands Reservoir (0.6)	547	62	26	1425
Hold-Up Pond A	Site runoff (0.031)	535	4	not found	52

(a) Source: Duke 2008b
(b) Source: Duke 2009c

Wetlands

Wetlands occurring on the Lee Nuclear Station site, in the London Creek drainage adjacent to the site, and in affected offsite areas are described in Section 2.4.1.

2.3.1.2 Groundwater Hydrology

Groundwater aquifers in the region of the Lee Nuclear Station site and Make-Up Pond C site are described in Section 2.3.1.5 of the ER (Duke 2009c, 2009b). The geology of each site is summarized in Section 2.8 of this environmental impact statement (EIS) and detailed in Section 2.5 of the FSAR (Duke 2013a).

The Lee Nuclear Station site and Make-Up Pond C site lie within the Piedmont physiographic province where rolling hills are cut by drainages with steep slopes. In undisturbed areas, the bedrock is overlain by unconsolidated materials. These materials include a soil zone known as residuum, or residual soil; a zone of weathered bedrock known as saprolite; and alluvium (Miller 2000). Alluvium is sediment deposited by flowing water, such as in a riverbed or river delta. During construction of the unfinished Cherokee Nuclear Station, some hills were removed, some drainages were filled, a substantial excavation was created, and a large relatively flat plateau was created for the unfinished units. Between the excavation and Hold-Up Pond A (to the north) approximately 60 ft of fill was placed to create the plateau surface at approximately 588 ft (Duke 2013a). To the east of the excavation, creation of the plateau required up to 40 ft of fill between the excavation and Make-Up Pond A. The site grade for the Lee Nuclear Station will be 593 ft. The long-term water table is expected to fluctuate between 584 and 574 ft (Duke 2013a).

A two-layer aquifer system that is more local than regional exists within the Piedmont physiographic province (Duke 2009c; Miller 2000). The upper aquifer is found in the saprolite strata, while the lower aquifer is found in the partially weathered and unweathered bedrock. Both aquifers are unconfined because there are no low-permeability strata isolating them, and consequently, the saprolite and bedrock materials are viewed as one interconnected aquifer. These aquifers are recharged by infiltration from local precipitation and by infiltration from adjacent natural and constructed surface waterbodies. Within this aquifer system water does not recharge to great depths before being redirected laterally by the low-permeability unweathered bedrock that has a lower fracture density (Duke 2009c). The interconnectedness of the soils and saprolite with the fractures of partially weathered and unweathered bedrock allow the overlying sediments to act as a reservoir with water moving vertically downward into fractures and then laterally to wells completed in the weathered bedrock (Miller 2000).

From a groundwater hydrology perspective, the Lee Nuclear Station site is bounded on the west by Make-Up Pond B with an approximate water surface elevation of 570 ft, on the north and northeast by the Broad River behind Ninety-Nine Islands Dam with an approximate water surface elevation of 511 ft, and on the east-southeast by Make-Up Pond A with an approximate water surface elevation of 547 ft (Duke 2009c). Private wells completed on properties on McKowns Mountain Road near the entrance to the Lee Nuclear Station site are the closest wells to the site. It is these wells that could affect or be affected by building and operating the proposed Lee Nuclear Station.

Prior to construction of the unfinished Cherokee Nuclear Station, water level measurements made on the proposed site and in nearby private wells revealed a water table that conformed to the surface topography and hydraulic gradients that sloped from the proposed reactor location toward the Broad River impounded behind Ninety-Nine Islands Dam (Duke Power Company 1974a, b, c). The original undisturbed Cherokee Nuclear Station site included numerous springs and seeps in locations that have since been cut or filled to create the landscape needed for the site. The changes created during that earlier building effort appear to have altered subsurface flow such that at many locations springs were buried or their flow disrupted (Duke 2009c).

A network of storm drains and buried piping was installed during site preparation for the unfinished Cherokee Nuclear Station. Some of these stormwater control structures remain onsite (Duke 2009c). Such structures located upgradient (i.e., to the south) of the nuclear island could intercept groundwater and allow it to drain toward Make-Up Pond A; however, such structures would not adversely affect groundwater in the vicinity of the power block (Duke 2013a). One such structure was designed to remove stormwater from the Cherokee Station power block. This existing storm drain and its associated materials will be removed by overexcavation when building proposed Lee Nuclear Station Units 1 and 2 (Duke 2013a).

When building proposed Lee Nuclear Station Units 1 and 2, additional excavation will be required to remove softened or loose soil and rock to expose relatively undisturbed materials (Duke 2013a). Additional grooming of the excavation slope will also be required to create the necessary foundation support zone for the nuclear island. Some additional excavation will be required in the vicinity of both proposed units (Duke 2013a).

Groundwater at the Lee Nuclear Station and Make-Up Pond C sites is found in the pore space of the overlying soils and saprolite and in the fractures of the partially weathered and unweathered bedrock (Duke 2009c). Of the natural materials, the partially weathered bedrock provides a consistent and connected fracture permeability and is generally the most hydraulically conductive aquifer media (Duke 2013a). The overlying soils and saprolite with their clay content and the underlying unweathered bedrock with sparse and poorly connected fractures (Duke 2009c, 2013a) provide lower conductivity. The undifferentiated material, which occurs to 100 ft deep, is composed of fill material, soil, saprolite, and partially weathered bedrock. These materials exhibit somewhat higher hydraulic conductivity values than the natural, undisturbed materials (Duke 2013a). However, the Cherokee-era site investigations that provide these results for the entire soil/sediment/rock profile could not be analyzed for properties of individual strata (Duke 2009d). An estimate of hydraulic conductivity in the partially weathered bedrock (i.e., conservative estimate 1.4×10^{-3} cm/s, maximum value 9.89×10^{-3} cm/s) was obtained from aquifer tests in 2006 and best represents the hydraulic conductivity of flow paths from the proposed units to the accessible environment (Duke 2013a). Total and effective porosity values for the partially weathered bedrock were reported as 27 and 8 percent, respectively (Duke 2013a).

Groundwater flows through the overlying soils and saprolite, into the underlying weathered and fractured bedrock, and then into the less conductive deeper unweathered bedrock. Potentiometric diagrams based on water level measurements completed between April 2006 and March 2007 (see Figure 2-10, Duke 2013a) suggest that groundwater flows either (1) toward the dewatered excavation or (2) off the plateau created for the unfinished Cherokee Nuclear Station and toward Hold-Up Pond A, Make-Up Ponds A and B, or the Broad River. A depiction of groundwater hydraulic head and flow consistent with an undisturbed site does not exist. From December 2005 until March 2006, preconstruction dewatering was undertaken to allow subsurface investigation of the pre-existing excavation. That dewatering effort, using a sump pit and sump pump approach, has continued unabated since March 2006 to maintain an essentially dry excavation supporting demolition of the unfinished Cherokee Nuclear Station Unit 1 structures. Duke reported the average maintenance dewatering rate through March 2007 as 0.39 cfs (250,000 gpd) (Duke 2008c). Accordingly, the year-long effort to collect groundwater hydraulic head data to understand the seasonal variations in the groundwater resource was biased by the dewatering stress on the aquifer. Data gathered from April 2006 and March 2007 at one onsite well (i.e., MW 1214) relatively far from the dewatering effort showed that the groundwater level declined during the late spring, summer, and early fall months and recovered during the late fall, winter, and early spring months—consistent with seasonal precipitation and evapotranspiration in the region (Duke 2009c).

Dewatering during the construction of the unfinished Cherokee Nuclear Station was achieved by pumping groundwater wells completed to depths of 200 to 280 ft below ground surface that were located outside the excavation and internal sump pits (Duke 2009c, 2013a). The drawdown that occurred during this first dewatering effort is shown in Figure 2-11; wells monitored by Duke between 1976 and 1985 outside the shadowed region were not affected (Duke 2013a). While groundwater levels and quality have been affected by mining excavations in the region (Castro et al. 1988), South Carolina Department of Health and Environmental Control (SCDHEC) staff did not find any record of problems or investigations associated with groundwater elevation or quality when building the unfinished Cherokee Nuclear Station (SCDHEC 2011a). The nearest residential well is located approximately 5000 ft south of the center of the excavation. Because dewatering effects extended less than 1700 ft to the south of the center of the excavation, the nearest offsite well was not affected. The extent of excavation and fill in the vicinity of the unfinished Cherokee Nuclear Station forms the initial landscape for the Lee Nuclear Station. Accordingly, less excavation and fill will be necessary to build the proposed Lee Nuclear Station Units 1 and 2.

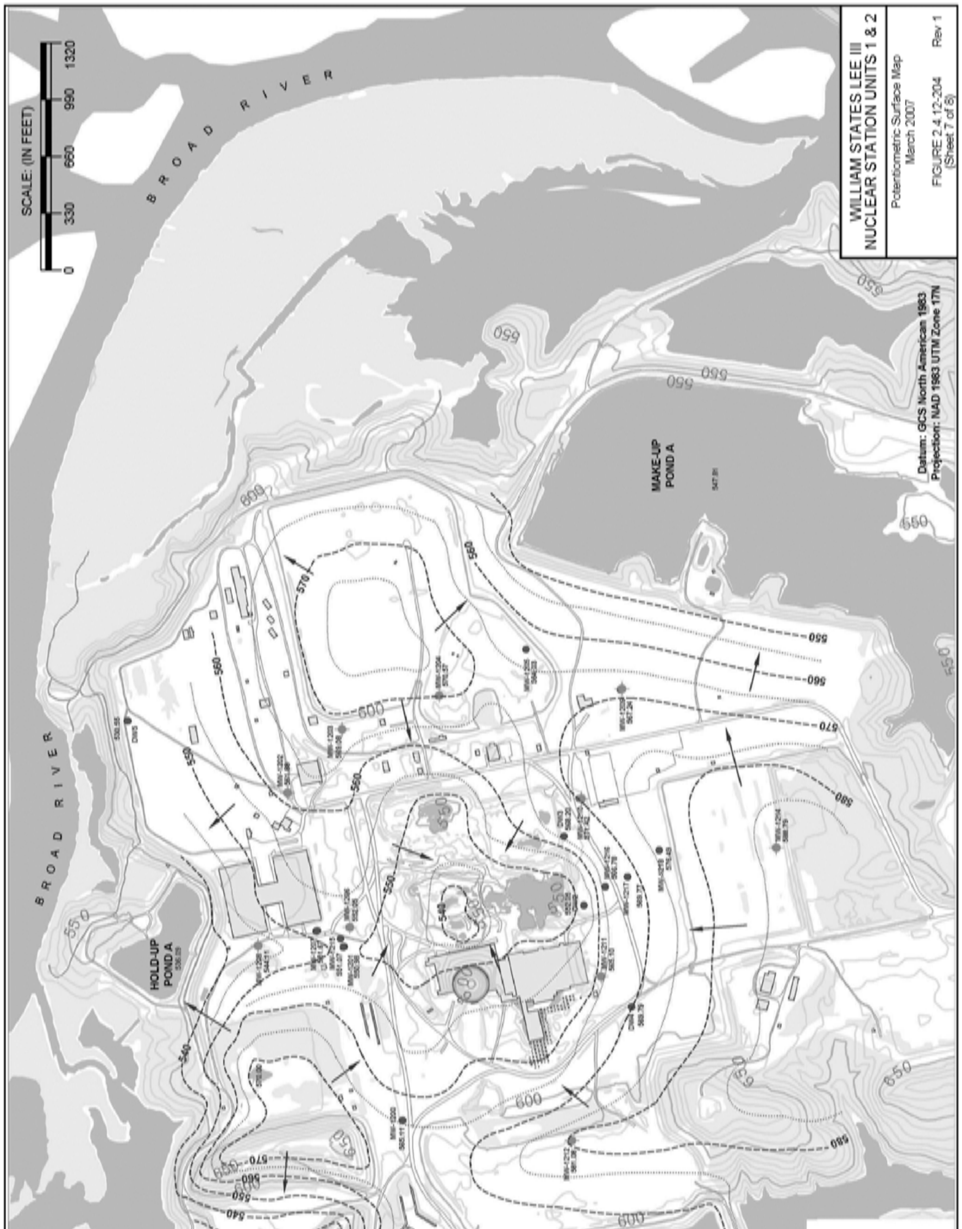

Figure 2-10. Potentiometric Surface Map of the Site of the Proposed Lee Nuclear Station, March 2007 (after Duke 2013a, FSAR Rev 7, Figure 2.4.12-204, sheet 7 of 8)

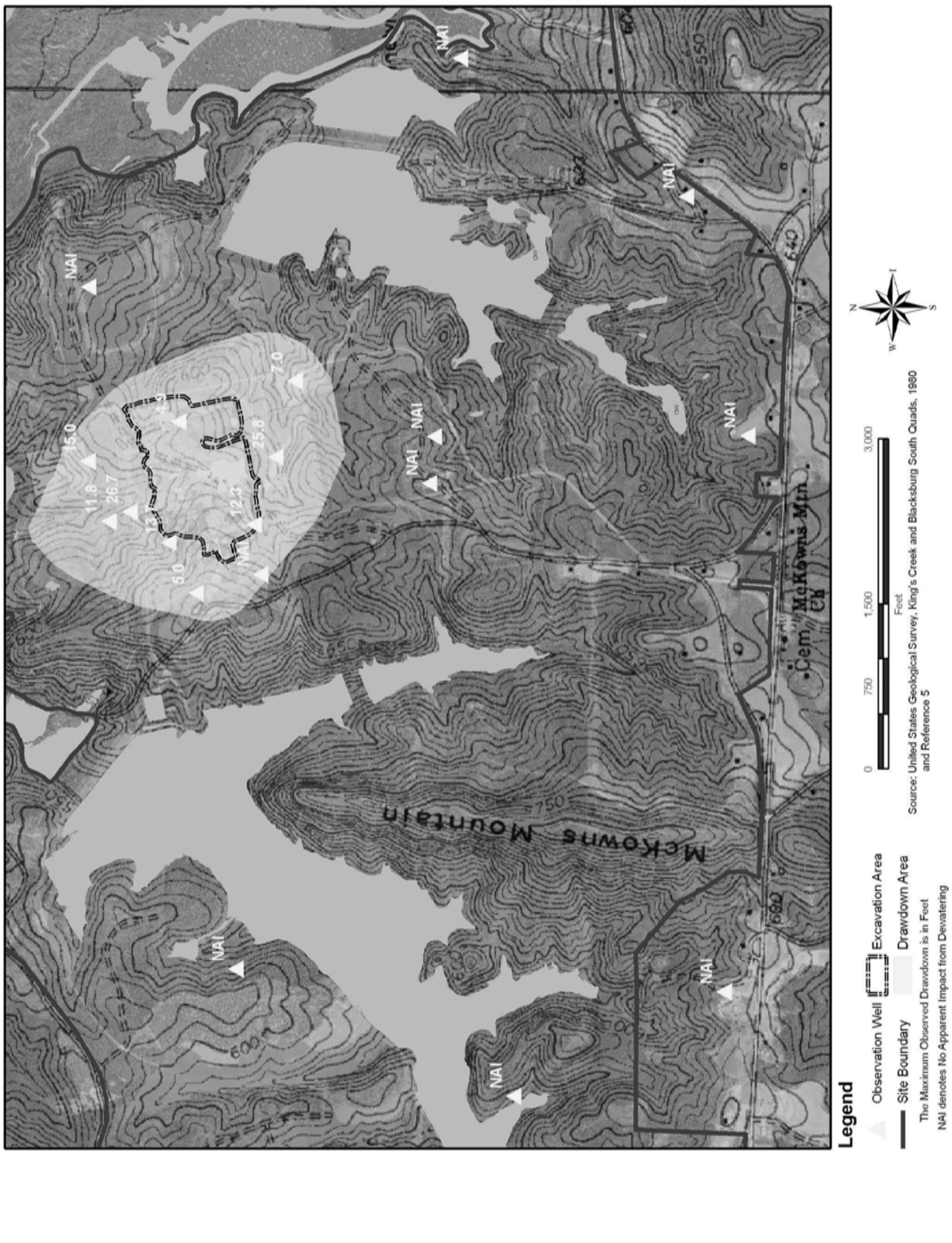

Figure 2-11. Area of Influence of Cherokee Nuclear Station Dewatering (after Duke 2009c, ER Rev 1, Figure 2.3-13)

The review team notes that the hydrologic system, including both surface water and groundwater, that served as a background during the construction at the unfinished Cherokee Nuclear Station has changed. During that earlier construction period, high points in the topography were removed and low points were filled to create the plateau at approximately 588 ft on which the unfinished Cherokee Nuclear Station was, and proposed Lee Nuclear Station Units 1 and 2 are to be constructed. The water table has changed accordingly. In addition, a ravine that was to the west of the nuclear island is now the site of Make-Up Pond B, with water at an approximate elevation of 570 ft. Where the earlier excavation dewatering created a cone of depression within the aquifer without contacting a surface-waterbody, the current dewatering effort and associated cone of depression may be influenced by the presence of Make-Up Pond B, because Make-Up Pond B's water level is above the elevation of the dry excavation (see Figure 2-4). Current hydraulic head data suggest a potential for this hydraulic connection between pond and excavation. However, because the dewatering product is being discharged into Make-Up Pond B during the current preconstruction effort, influence on the pond has been minimal or non-existent.

Duke postulates several alternative conceptual models of the groundwater pathway from the Lee Nuclear Station site to the accessible environment. Possible receptor locations include (1) Hold-Up Pond A, (2) the Broad River, (3) Make-Up Pond A, (4) a wetland located northwest of the nuclear island, and (5) Make-Up Pond B (Duke 2009c). An analysis of alternative groundwater pathways including alternative conceptual models of flow and transport, and evaluation of the potential effects of a postulated accidental release in the vicinity of the power block is in the FSAR Sections 2.4.12 and 2.4.13 (Duke 2013a).

To simplify the analysis of the potential for future contaminant transport in this groundwater environment, Duke has proposed use of the concept of a single, worst-case, straight-line, shortest-distance, highest-conductivity pathway. This results in a straight-line pathway from the proposed power block to the receptor location. All pathways were assumed by Duke to have the partially weathered bedrock values for hydraulic conductivity and effective porosity. The shortest travel time pathway was identified from proposed Unit 2 to Hold-Up Pond A and has an estimated travel time of 1.5 years (Duke 2013a).

The Make-Up Pond C study area is located in the London Creek drainage, to the west and offsite from the Lee Nuclear Station site (Figure 2-4) (Duke 2009b). Elevations within the London Creek watershed range from a topographic high north of London Creek (763 ft), to the proposed Make-Up Pond C water level (650 ft), and to 535 ft at the proposed main dam for the pond. Groundwater levels in the study area vary from approximately 27 to 50 ft below ground surface, and generally mirror the surface topography. Based on measurements of hydraulic properties within the Make-Up Pond C study area and considering estimates based on Lee Nuclear Station site analyses, pore-water velocity is estimated to range from 26 to 37 ft/yr in the saprolite strata, and from 71 to 100 ft/yr in the partially weathered and upper crystalline rock strata.

2.3.2 Water Use

Consideration of water use requires estimating the magnitude and timing of consumptive and non-consumptive water use. Non-consumptive water use does not result in a reduction in the water supply available. For instance, water used to return fish from the water-intake structure to the reservoir would result in no change in the water supply, as the same volume of water pumped from the reservoir would eventually be returned to the reservoir. However, consumptive water-use results in a reduction of the water supply available. For instance, reservoir evaporation results in a transfer of water from the reservoir to the atmosphere, thereby reducing the reservoir volume. The following two sections describe consumptive and non-consumptive uses of surface-water and groundwater.

2.3.2.1 Surface-Water Use

An analysis of water-supply uses and needs for the Broad River basin was documented by Duke Energy (Duke Energy 2007). This study divided the Broad River basin into 40 sub-basins. Existing and projected water withdrawals and returns were estimated for each sub-basin for power, agricultural, public water, and industrial sectors. The net consumptive use for the Broad River basin (withdrawal less return) for 2006 was estimated as 241 cfs. This represents 4.5 percent of the mean annual flow of the basin (5342 cfs) as measured at the Alston gage near Columbia, South Carolina, for the period of record 1981-2010 (USGS 2010b).

2.3.2.2 Groundwater Use

Duke describes groundwater use in the vicinity of the Lee Nuclear Station site in Section 2.3.2.2 of the ER (Duke 2009c). Groundwater use in the immediate vicinity of the Lee Nuclear Station site is limited to individual residences located along McKowns Mountain Road near the entrance to the site (Duke Power Company 1974a, b, c; Duke 2009c). The nearest private well is approximately 5000 ft from the proposed Lee Nuclear Station Unit 1 and 2 power block. The Gaffney Board of Public Works, which withdraws water from the Broad River, provides potable water in the area, including the cities of Gaffney and Draytonville, South Carolina (Duke 2009c). However, some residences in the vicinity of proposed Lee Nuclear Station Units 1 and 2 continue to rely on residential wells for potable water. In 1999, public water supply was not available to residences within 2 mi of the proposed Lee Nuclear Station; however, almost a decade later it was estimated that 83 percent of those residences have the option of public water supply and 59 percent are connected to the public supply (Duke 2008d).

Duke does not plan to use either groundwater or surface water produced at the site while building proposed Lee Nuclear Station Units 1 and 2 (e.g., fire protection, dust control, concrete batch plant operation, potable or sanitary water). All such water requirements will be satisfied by the Draytonville Water District (Duke 2009c). Potable water during operation of the plant will also be provided by the Draytonville Water District.

Duke describes groundwater use in the vicinity of the proposed Make-Up Pond C study area in Section 2.3.2.2.1 of the ER (Duke 2009b). While many residences outside the area to be inundated by the proposed Make-Up Pond C have the option of connecting to the public water supply, residences adjacent to the proposed Make-Up Pond C that currently rely on groundwater wells as a domestic water supply may continue to do so.

2.3.3 Water Quality

The following sections describe the water quality of surface-water and groundwater resources in the vicinity of the Lee Nuclear Station site. Pre-application monitoring programs for thermal and chemical water quality are also described.

2.3.3.1 Surface-Water Quality

The Broad River is both the water-supply source for proposed Lee Nuclear Station Units 1 and 2 and the receiving water for plant discharges. Water quality in the Broad River has been regularly evaluated and compared to State water-quality standards by the SCDHEC watershed water-quality assessment program. Waterbodies that do not meet State standards are identified on a Clean Water Act Section 303(d) list of impaired waters based on levels of metal and organic constituents, dissolved oxygen, fecal coliform, nutrients, pH, the presence of biota, and organism tissue evaluations (SCDHEC 2010a). Several stations in the upper Broad River watershed are listed as impaired for aquatic life use because of macroinvertebrate survey results or copper concentration. In 2008, the two stations nearest the proposed site (i.e., B-062 Thicketty Creek and B-042 Broad River 4 mi northeast of Gaffney) and sites further upstream and downstream were listed as impaired because the copper standard was exceeded. However, these stations were removed from the 303(d) list of impaired waterbodies in 2010, when the copper standard was attained in all but a few stations in the Pacolet River watershed (SCDHEC 2010a). The Pacolet River enters the Broad River downstream of the Lee Nuclear Station site.

In 2006, Duke (2009b, c) conducted pre-application quarterly water-quality sampling at five stations in the main channel and two stations in the backwater areas of the Broad River near the site. Constituent information for the five stations located in the main channel is summarized in Table 2-6. Duke compared water-quality monitoring data from 2006 with historical data from extensive sampling done in 1973 and 1974, in advance of building activities for the unfinished Cherokee Nuclear Station, and in 1989 and 1990 above and below Ninety-Nine Islands Dam in support of Ninety-Nine Islands Hydroelectric Project. Most 2006 water-quality measurements were found to be consistent with historical data (Duke 2009c). The copper concentration in one of the 2006 samples exceeded the water-quality standard (underlined maximum in Table 2-6), but copper was not detected in most samples and the mean copper concentration was below the standard (Duke 2009c). As noted above, the Broad River in the vicinity of the Lee Nuclear Station site is no longer considered to be impaired for aquatic life uses because of copper (SCDHEC 2010a).

Table 2-6. Broad River Water Quality Near the Lee Nuclear Station Site

Constituent	Units	South Carolina CMCs for Freshwater Aquatic Life[(a)]	Concentration in Broad River Near the Lee Nuclear Station Site[(b)]	
			Mean	Maximum
Aluminum	mg/L	--	0.163	0.268
Arsenic	µg/L	340	0.36	2.18
Barium	µg/L	--	19.2	22.4
Boron	mg/L	--	<0.1	<0.1
Cadmium	µg/L	0.53	<0.5	<0.5
Chromium	µg/L	--	0.827	1.68
Copper	µg/L	3.8	1.31	4.97[(c)]
Iron	mg/L	--	0.855	1.11
Lead	µg/L	14	<2	<2
Magnesium	mg/L	--	1.67	1.88
Manganese	µg/L	--	47.7	61.9
Mercury	µg/L	1.6	<0.087	<0.1
Nickel	µg/L	150	0.128	2.95
Selenium	µg/L	--	<2	<2
Silver	µg/L	0.37	<0.5	<0.5
Sulfate	mg/L	--	6.26	9.77
Zinc	µg/L	37	5.44	12.6

Source: Duke 2009b
(a) South Carolina Water Classifications and Standards Regulation 61-68 (June 22, 2012) established maximum concentrations for freshwater (CMCs) (SCDHEC 2012a).
(b) Calculated from quarterly monitoring (February, May, August, November 2006) at five stations within the main channel of the Broad River.
(c) Exceeds CMC value.
CMC = criterion maximum concentration, mg/L = milligrams per liter, µg/L = micrograms per liter.

In Duke's 2006 and earlier (1970s) water-quality studies near the Lee Nuclear Station site, field measurements of water surface temperature were found to be the same as or very close to the ambient air temperature at the time of sampling. To better characterize the water temperature regime in Ninety-Nine Islands Reservoir, Duke monitored temperature hourly from early December 2006 through June 2008 at two locations, one about 1 mi upstream of the proposed intake location, and one at the intake location. In March 2008, Duke added a temperature logger in the dam forebay near the proposed discharge location. Temperature patterns were seasonal, ranging from a low of 38°F in winter to highs of 90°F (2008) and 92°F (2007) in summer, and consistent between all stations in the reservoir (Duke 2009c). In May through August 2007 and between January and early August 2008, Duke also monitored temperature hourly at four locations just below (i.e., within about 0.5 mi of) the dam. The temperature regime below the dam followed the same seasonal pattern as the reservoir, but very low and very high temperatures appeared to fluctuate more below the dam (Duke 2009c).

2.3.3.2 Groundwater Quality

Groundwater characterization during construction of the unfinished Cherokee Nuclear Station Units 1 and 2 (1970s) provided a baseline for groundwater quality discussed in Section 2.3.3.2 of the ER (Duke 2009b, c). While more recent sampling provides a more complete water-quality characterization, the prior and recent work both report results for pH, dissolved solids, alkalinity bicarbonate as $CaCO_3$, total hardness, iron, calcium, magnesium, chloride, sulfate, turbidity, and specific conductance. The results of recent monitoring (i.e., 2006 to 2007) are consistent with the earlier baseline (Duke 2009c) where iron is above its standard in both characterizations (EPA 2008a).

Duke collected samples quarterly from monitoring wells at the Lee Nuclear Station site from May 2006 through February 2007 and reported the results in its ER (Duke 2009c). The recent average concentrations for the metals iron (average, Secondary Maximum Concentration Limits [SMCLs]; 0.41 mg/L, 0.3 mg/L) and manganese (165 μg/L, 50 μg/L) exceeded U.S. Environmental Protection Agency (EPA) Drinking Water Standard SMCLs. The average concentration for the metal aluminum (i.e., average 0.33 mg/L, SMCL range 0.05 to 0.2 mg/L) and the average value for pH (average 6.08 SMCL range 6.5 to 8.5 were also found outside their acceptable SMCL ranges (Duke 2009c). The EPA has established Secondary Drinking Water Standards as guidelines to assist public water systems in managing aesthetic considerations such as the taste, color, and odor of drinking water. Contaminants at the SMCL level are not considered to present a risk to human health, and public water systems test for them on a voluntary basis. If the groundwater were a public water supply using conventional or direct filtration, the recently reported results for turbidity would require filtration to lower its measurement to no greater than 1 nephelometric turbidity unit. The USGS noted that elevated concentrations of iron may arise from groundwater flow through mineralized zones or due to the action of iron-fixing bacteria. However, the USGS also noted that groundwater with elevated levels of iron and manganese can be rendered potable through oxidation and filtration (Miller 2000).

Groundwater samples were also collected and analyzed at wells installed for the hydrogeologic assessment of proposed Make-Up Pond C (Duke 2009b). Analytical results for the offsite Make-Up Pond C study area are similar to the results reported in the preceding paragraph for the Lee Nuclear Station site.

All sanitary service for both building and operation of the Lee Nuclear Station would be provided by the Gaffney Board of Public Works, with treatment of the waste occurring at an offsite location (Duke 2009c).

2.3.4 Water Monitoring

Duke outlines programs for hydrologic and chemical monitoring related to proposed Lee Nuclear Station Units 1 and 2 in ER Sections 6.3 and 6.6 (Duke 2009c).

2.3.4.1 Surface-Water Monitoring

Broad River flows are monitored continuously at several USGS gaging stations near the Lee Nuclear Station site; Table 2-4 lists gaging stations both upstream and downstream of the site along with their periods of record for streamflow measurements. The nearest continuous temperature monitoring site is the gage at Carlisle, approximately 50 mi downstream of Ninety-Nine Islands Dam. Other water-quality parameters (e.g., dissolved oxygen, suspended solids, bacteria, nutrients, and chemical contaminants) have been measured periodically by the SCDHEC to characterize basin-wide water quality. As described in Section 2.3.3.1, Duke conducted site-specific surface-water-quality monitoring studies in the 1970s prior to building the unfinished Cherokee Station and in 1989 and 1990 for Ninety-Nine Islands Hydroelectric Project. More recently, Duke conducted water-quality monitoring (2006) and thermal monitoring (2007 and 2008) in the Broad River, Make-Up Pond A, and Make-Up Pond B in support of the COL application for proposed Lee Nuclear Station Units 1 and 2 (Duke 2009c).

2.3.4.2 Groundwater Monitoring

The pre-application groundwater monitoring program began in March 2006 to evaluate the current hydrogeologic conditions at the Lee Nuclear Station site (Duke 2009c). In addition, Duke collected groundwater-quality samples in February and May 2009 at the proposed Make-Up Pond C study area (Duke 2009b). Duke installed 24 monitoring wells to measure groundwater elevation at the Lee Nuclear Station site. Groundwater elevation data were reported from April 18, 2006 through April 19, 2007, and are shown in seven plots from April 2006 through March 2007 (Duke 2009c). Ten of the monitoring wells were also used in the baseline water-quality study for the site. Eight wells were sampled during the baseline water-quality study for the Make-Up Pond C study area (Duke 2009b). Groundwater samples were collected and analyzed quarterly for the Lee Nuclear Station site (Duke 2009c) and in February and May 2009 for the Make-Up Pond C study area (Duke 2009b). Results of the pre-application groundwater-quality sampling for the Lee Nuclear Station site and the Make-Up Pond C study area are generally consistent with historical sampling results completed for the unfinished Cherokee Nuclear Station (Duke 2009b, c).

2.4 Ecology

This section describes the terrestrial and aquatic ecology of the site and vicinity that might be affected by building, operating, and maintaining the proposed Lee Nuclear Station Units 1 and 2. Sections 2.4.1 and 2.4.2 provide general descriptions of terrestrial and aquatic environments on and near the Lee Nuclear Station site (including proposed Make-Up Pond C), the two proposed new transmission corridors, the railroad corridor for the existing spur that would be renovated and partially rerouted, and offsite road-improvement areas.

Detailed descriptions are provided, as needed, to support the analysis of potential environmental impacts from building, operating, and maintaining new nuclear power generating facilities, new transmission-line corridors, the railroad-spur corridor, and offsite road improvements. These descriptions also support the evaluation of mitigation activities identified during the assessment to avoid, reduce, minimize, rectify, or compensate for potential impacts. Descriptions also are provided to help compare the alternative sites to the Lee Nuclear Station site. Also included are descriptions of monitoring programs for terrestrial and aquatic environments.

The information in this section is based on qualitative data recently gathered to determine the distribution and abundance of fauna and flora and waters of the United States on the Lee Nuclear Station site, within the Make-Up Pond C study area, within the two new transmission-line corridors, along the existing and rerouted portions of the railroad-spur corridor, and at offsite road-improvement areas. Supplementary information was taken from the Cherokee Nuclear Station ER (Duke Power Company 1974a, b, c).

Some fauna and flora species have special status designations that are used throughout the ecology sections of the EIS. Federal listings for animal and plant species are issued by the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS). State species designations include NatureServe, State conservation status ranks (State ranks) and State legal listings. State ranks typically are complementary to State legal listings. However, State legal listings are conversely used to complement State ranks in the EIS based on the following rationale. State ranks are used by State natural resource agencies for both animal and plant species in South Carolina, North Carolina, and Georgia. State legal listings are used by State wildlife agencies for only animal species in South Carolina and for both animal and plant species in North Carolina and Georgia. Because State ranks apply to both animal and plant species in all three states, they are used (in addition to the Federal listing) to compare the proposed Lee Nuclear Station site located in South Carolina, the Keowee and Middleton Shoals alternative sites also located in South Carolina, and the Perkins alternative site located in North Carolina (see Chapter 9). For consistency, State ranks are also used in the ecology sections throughout the other chapters in the EIS. The staff considered species ranked as critically imperiled (S1), imperiled (S2), or vulnerable (S3). Further, State legal listings are provided in the EIS as an indication of the importance a State places on the conservation of a species. In some instances, NatureServe global conservation status ranks are used to provide an indication of the viability of a species across its range when discussing potential impacts (see Chapter 4). Categories of Federal listings, NatureServe State ranks, global conservation status ranks, and State legal listings are defined in the footnotes of applicable tables throughout the EIS. In addition to animal and plant species that fall under the above special status designations, conservation priority species, deemed by the South Carolina Department of Natural Resources (SCDNR) in the *South Carolina Comprehensive Wildlife Conservation Strategy* (SCDNR 2005) to be of conservation concern in the State, are also discussed. Finally, avian species considered of conservation priority to the Atlantic Coast Joint Venture, a consortium of public, private, and conservation groups focused on the conservation of habitat for native birds in the Atlantic Flyway, are discussed. Note that the terminology "State species of concern" is commonly used but is not an official designation in the State of South Carolina, where all species tracked by the SCDNR that are not threatened or endangered under Federal or State law are considered to be of concern. Thus, "State species of concern" was not used in the EIS (SCDNR 2011a).

Duke delineated wetlands, streams, and open water areas for the various project components (e.g., Lee Nuclear Station site, Make-Up Pond C study area) within its established project component boundaries (Duke 2009b, c). In some instances, Duke redefined these boundaries slightly for purposes of its application to the USACE for a Department of the Army permit (Duke 2011h). Wetland acreages, stream lengths, and open water acreages in Chapter 2 of the EIS are based on the USACE boundaries for the jurisdictional determination (USACE 2013a) instead of Duke's permit application boundaries (Duke 2011h) or Duke's original project component boundaries (Duke 2009b, c).

Duke delineated wetlands, streams, and open water areas for the two new transmission-line corridors within boundaries established in the Duke Energy *Siting and Environmental Report for the William States Lee III Nuclear Station 230 kV and 525 kV Fold-In Lines, Cherokee and Union Counties, SC* (Duke 2007c) (HDR/DTA 2009b). The original total area of these two corridors is about 987 ac (Duke 2007c). However, Duke defined the permit area for the two transmission-line corridors in its application to the USACE for a Department of the Army permit to include a total of 5760 ac (Duke 2011h). Quantifications of wetlands, streams, and open water areas in Chapter 2 of the EIS for the two transmission-line corridors are, as indicated above, based on the USACE jurisdictional determination instead of Duke's permit application boundaries. The jurisdictional determination boundaries are consistent with the original boundaries in Duke's transmission-line siting report (Duke 2007c).

2.4.1 Terrestrial and Wetland Ecology

This section identifies terrestrial and wetland ecological resources and describes species composition and other structural and functional attributes of biotic assemblages that could be affected by building, operating, and maintaining the proposed Units 1 and 2, two new transmission-line corridors, each containing both the Lee Nuclear Station 230-kV transmission line and the Lee Nuclear Station 525-kV transmission line, the existing railroad-spur corridor that would be renovated and partially rerouted, and several offsite road improvements. It also identifies "important" terrestrial resources, including habitats and species that might be affected by the proposed action.

2.4.1.1 Terrestrial Resources – Lee Nuclear Station Site

The Lee Nuclear Station site, the Make-Up Pond C site, the proposed two new transmission corridors, the railroad-spur corridor, and offsite road-improvement areas are located in two of five subdivisions of the Piedmont ecoregion of South Carolina. The Piedmont is a northeast-southwest trending ecoregion that is approximately 160 km (100 mi) wide that comprises a transitional area between the mostly mountainous ecoregions of the Appalachians (Blue Ridge) to the northwest and the relatively flat coastal plains ecoregions (Southeastern Plains) to the southeast (EPA 2007a). Major land-cover transformations in the Piedmont over the past 200 years include conversion from hardwood forest to farm and then from farm back to forest. The South Carolina Piedmont was once largely cultivated with crops such as cotton, corn, tobacco, and wheat. Most of this region is now planted in loblolly pine (*Pinus taeda*), which was introduced as a cash crop on monotypic pine plantations during the nineteenth century (Duke 2009c), or has reverted to successional pine and hardwood woodlands with some pasture (Griffith et al. 2002).

The proposed Lee Nuclear Station, proposed Make-Up Pond C, railroad-spur corridor, and offsite road-improvement areas are located in the Kings Mountain subdivision of the Piedmont ecoregion, and the proposed two new transmission-line corridors are located in this and the Southern Outer Piedmont subdivision (EPA 2007a). The Kings Mountain subdivision is a hilly area with northeast to southwest trending ridges that are covered with oak-hickory-pine forest and Virginia pine (*P. virginiana*) (Griffith et al. 2002). The Southern Outer Piedmont subdivision has mostly irregular plains where pine dominates on old field sites and pine plantations and mixed oak forest are found in less heavily altered areas. The northern portion of the subdivision where a portion of the new transmission-line corridors would be located tends to have more pasture and cropland, while the landscape of the southern portion of the region now is dominated by loblolly pine plantations (Griffith et al. 2002).

The remainder of this subsection covers the terrestrial and wetland ecologies of the Lee Nuclear Station site. The terrestrial and wetland ecologies of the Make-Up Pond C site, the two new transmission-line corridors, the railroad-spur corridor, and the offsite road-improvement areas are covered in Sections 2.4.1.2, 2.4.1.3, 2.4.1.4, and 2.4.1.5, respectively.

Existing Cover Types

The areal extent of the existing cover types on the Lee Nuclear Station site is summarized in Table 2-7. The proposed site consisted almost entirely of second-growth forest in various stages of succession prior to building activities for the unfinished Cherokee Nuclear Station (Duke 2009c). In addition to forest, active and abandoned agricultural fields and pasture, wetlands, and alluvial thickets were present. Terrestrial ecological conditions on the proposed site were extensively altered by grading and building and creating water storage reservoirs for the unfinished Cherokee Nuclear Station (Duke 2009c).

Table 2-7. Acreage Occupied by Various Cover Types at the Lee Nuclear Station Site

Cover Type	Description	Acres	Percent of Total
Open/field/ meadow	Non-forested areas dominated by grasses, herbs, or bare soil maintained by cattle grazing and/or mowing	441.17	22.9
Mixed hardwood	Stands dominated by mixed hardwood with little or no pine in the canopy	418.87	21.7
Mixed hardwood-pine	Stands dominated by mixed hardwood with pine in the canopy	312.12	16.2
Pine-mixed hardwood	Stands dominated by pine with mixed hardwood in the canopy and understory	228.51	11.9
Upland scrub	Partially forested early successional, scrubby areas	154.21	8.0
Open pine-mixed hardwood	Selectively cut stands with scattered pine in canopy and mixed hardwood understory	70.24	3.6
Pine	Young to mid-aged pine stands/plantations with no hardwoods in canopy	17.41	0.9
Open water[(a)]	Reservoirs and ponds under regulatory authority of the USACE	260.47	13.5
Wetland[(b)]	Backwater emergent wetland associated with ponds, impoundments, and upland depressions	15.96	0.8
Non-jurisdictional feature	Disturbed, open, man-made wet area not under regulatory authority of the USACE	9.25	0.5
	Total[(c)]	**1928.21**	**100**

Source: Duke 2013d. The delineation of existing ecological cover types was updated to include the current boundaries of waters of the United States based on results of the approved jurisdictional determination received from the USACE (USACE 2013a).

(a) Acreage of open water in this table is smaller than what is provided in the jurisdictional determination (262.54 ac) (USACE 2013a) because the 2008 site boundary does not include areas of Ninety-Nine Islands Reservoir (Duke 2013d).

b) Acreage of wetland in this table is larger than what is provided in the jurisdictional determination (12.52 ac) (USACE 2013a) due to the smaller size of the project area submitted for the jurisdictional determination (Duke 2013d).

(c) After issuance of the draft EIS, the site boundary was updated using survey information (Duke 2013d), thus the revised total.

During that period, Duke Power Company cleared and graded approximately 750 ac of the more than 1900 ac for the unfinished Cherokee Nuclear Station (Duke 2009c), impounded riparian and upland habitat associated with much of the 23,000 linear ft of streams with the creation of Make-Up Pond A and Make-Up Pond B (Duke 2011h), and cleared about 41 ac to create the railroad corridor. Currently, this core building area on the Lee Nuclear Station site is designated primarily as the open/field/meadow cover type shown in Figure 2-12. After cancelling the Cherokee project and selling the site, cleared areas may have been maintained through mowing and cattle grazing and pastures seeded with non-native fescue (*Festuca* spp.). The upland scrub type that commonly occurs around the periphery of the core building area (Figure 2-12) represents early successional encroachment into the area (Duke 2009c). The open/field/ meadow and upland scrub habitat types were not present on the site prior to 1975 when

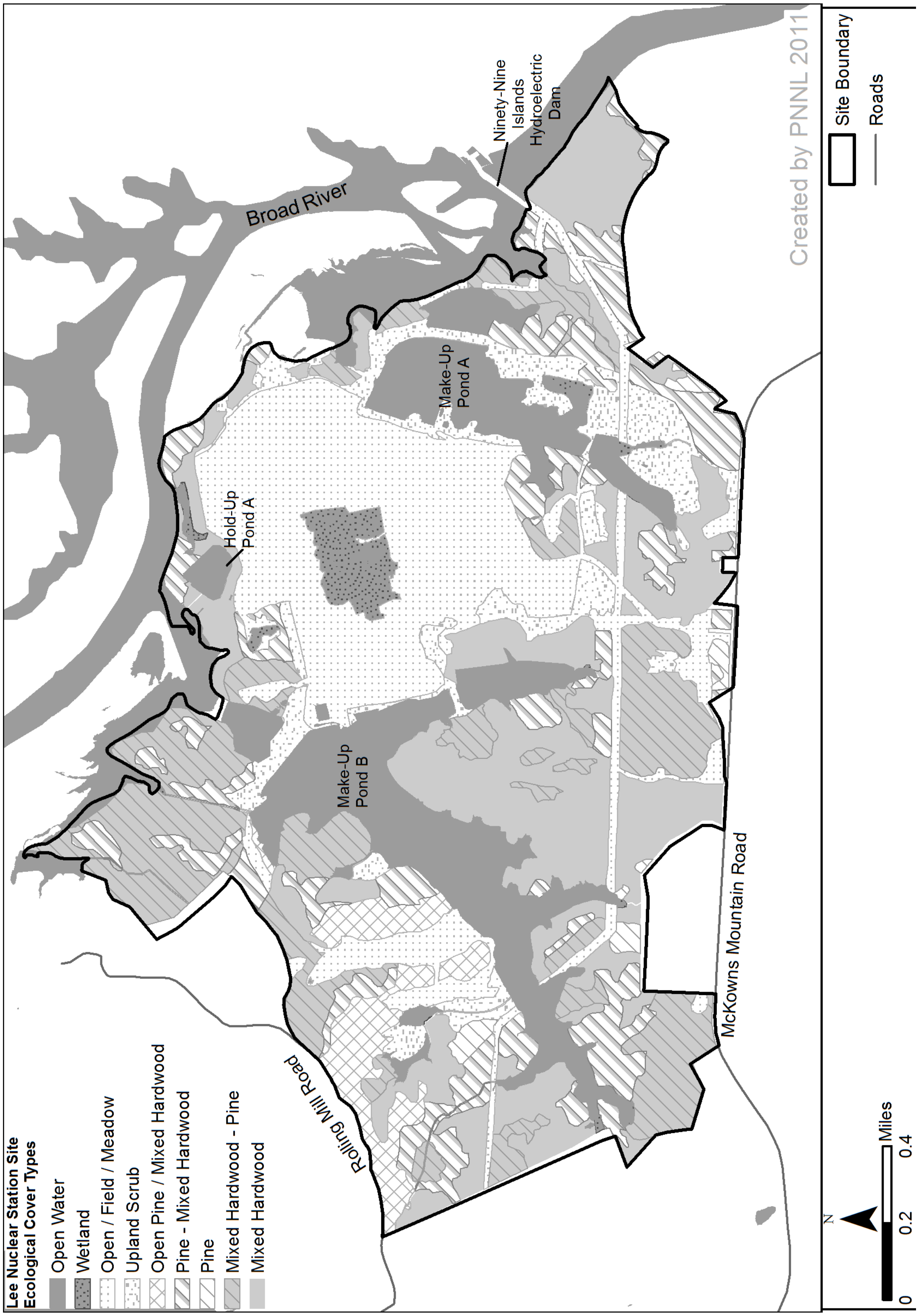

Figure 2-12. Ecological Cover Types on the Lee Nuclear Station Site (based on information provided in Duke 2013c)

construction of the Cherokee Nuclear Station began (Duke Power Company 1974a, Duke 2008a). Also included in the 750 ac are eight non-jurisdictional features, five of which developed in abandoned excavations intended for unfinished Cherokee Nuclear Station facilities (USACE 2013a).

The second-growth forest that remains onsite from prior to construction activities associated with the unfinished Cherokee Nuclear Station, and the open/field/meadow cover type and the upland scrub cover type that resulted from those construction activities would eventually revert to oak-hickory or mesophytic hardwood communities if left undisturbed. Oak-hickory is considered a typical climax forest for dry ridges and well-drained gentle slopes, and mesophytic hardwood communities are considered typical climax forests for more mesic and north-facing slopes, on the Lee Nuclear Station site (Duke Power Company 1974a, b, c; Duke 2011h).

Duke Power Company also dammed what was formerly McKowns Creek, then a perennial stream, to form the nuclear service-water pond, now referred to as Make-Up Pond B. A backwater of the Broad River was dammed to form Make-Up Pond A (Duke 2009c). Make-Up Ponds A and B are now jurisdictional waters of the United States (USACE 2013a). A small stream and a backwater of the Broad River were dammed to create the former stormwater retention pond, now referred to as Hold-Up Pond A (Duke 2009c), which is now a jurisdictional water of the United States (USACE 2013a). These ponds, together with two smaller ponds and two small sections of the Broad River associated with proposed plant-related structures, total approximately 262.5 ac and appear as the jurisdictional open water cover type in Figure 2-13. Jurisdictional wetlands developed in some areas along the margins of Make-Up Ponds A and B, in the forested bottomland along the Broad River floodplain, and in upland areas along streams (Figure 2-13) (USACE 2013a). In addition, about 3.9 mi of jurisdictional streams occur on the Lee Nuclear Station site (USACE 2013a).

In 2006, a map of vegetation cover types at the Lee Nuclear Station site was developed based on false color infrared aerial photographs taken in 1999, which were the most recent photographs available. During April and June 2006, the map was ground-truthed (Duke 2009c, 2008e). The vegetation types (mostly forest) that were present on the Lee Nuclear Station site in 1975 (Duke Power Company 1974a, b, c) continue to exist there but the areal extent is less (Duke 2009c). These vegetation types also are common and widespread elsewhere in the Piedmont ecoregion and are representative of several broader natural community types described by Nelson (1986) and SCDNR (2005) for the State of South Carolina. Duke grouped these vegetation types, as well as wetlands and open water, into cover type in support of the Lee Nuclear Station COL application (Figure 2-12), in part to reflect the effects of building the unfinished Cherokee Nuclear Station (Duke 2009c).

In summary, clearing land, building facilities, and creating impoundments for the unfinished Cherokee Nuclear Station altered a large amount of upland habitat (mostly forest) on the Lee Nuclear Station site; these activities resulted in the creation of new early successional and

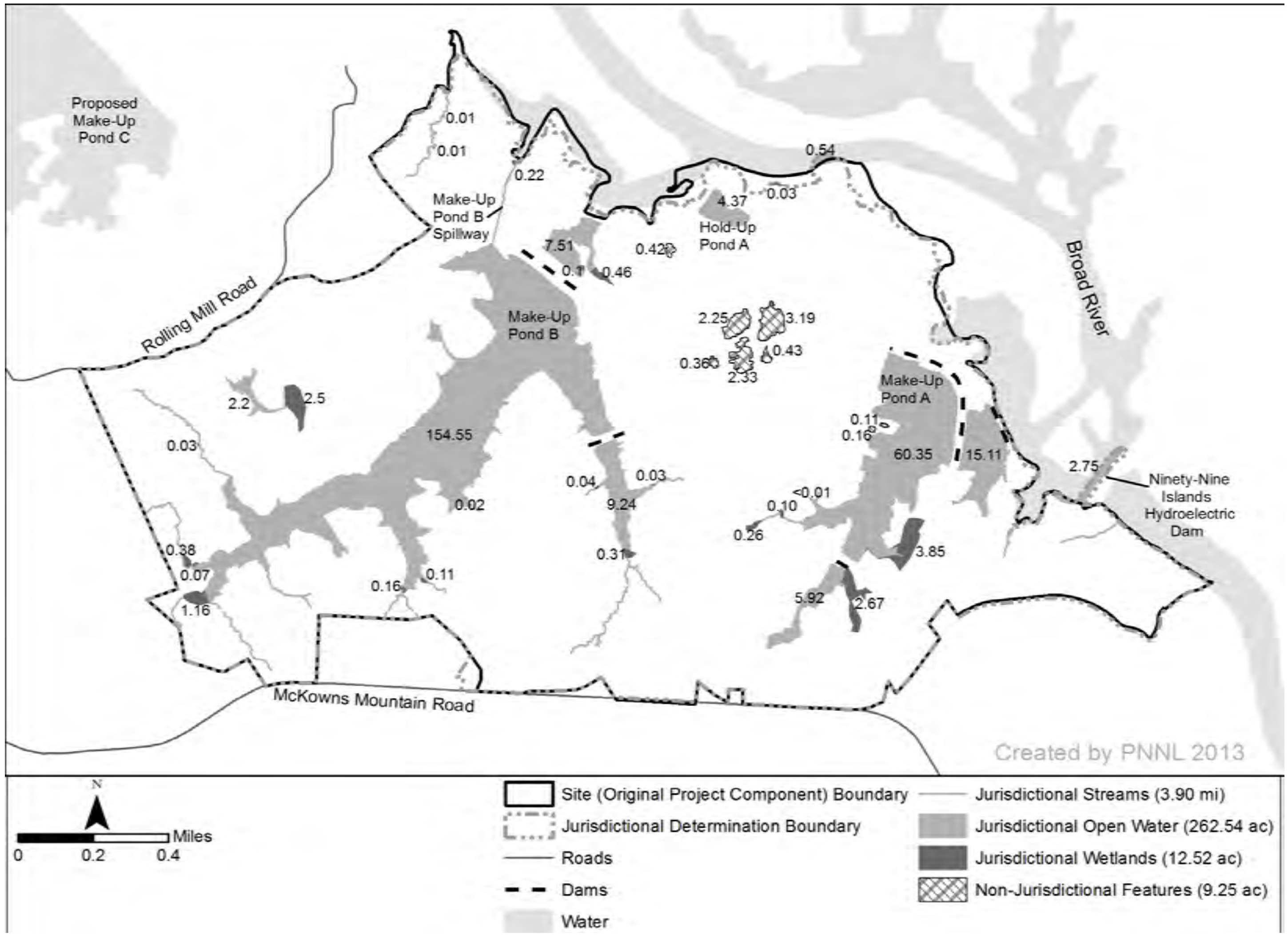

Figure 2-13. Wetlands and Waterbodies within USACE Jurisdictional Boundaries on the Lee Nuclear Station Site (acreages for jurisdictional wetlands, jurisdictional waterbodies, and non-jurisdictional features obtained from the USACE [2013a])

wetland habitats. Thus, current upland and wetland habitats on the Lee Nuclear Station site appear to be more diverse than those that were identified prior to construction of the Cherokee Nuclear Station.

<u>Mixed Hardwood</u>

The mixed hardwood cover type is the most biologically diverse plant community at the Lee Nuclear Station site. It occupies a total of 418.87 ac (21.7 percent) of the site and comprises different species assemblages at different locations (Duke 2009c, 2013d). These communities are included in the oak-hickory, mesic mixed hardwood, chestnut oak (*Quercus montana*), and basic forest types described by Nelson (1986).

On the north side of the Lee Nuclear Station site near the Broad River, dry bluffs support communities dominated by chestnut oak with northern red oak (*Q. rubra*), white oak (*Q. alba*), and tulip poplar (*Liriodendron tulipifera*). Communities on the lower slopes near the river and floodplain are dominated by black oak (*Q. velutina*), shortleaf pine (*P. echinata*), and Shumard oak (*Q. shumardii*), with white ash (*Fraxinus americana*), cottonwood (*Populus* spp.), sweet gum (*Liquidambar styraciflua*), and cucumber magnolia (*Magnolia acuminata*) as subdominants. The mixed hardwood subcanopy is dominated by redbud (*Cercis canadensis*), chalk maple (*Acer leucoderme*), dogwood (*Cornus spp.*), American holly (*Ilex opaca*), and eastern red cedar (*Juniperus virginiana*). The mixed hardwood shrub layer supports pawpaw (*Asimina triloba*) and giant cane (*Arundinaria gigantea*), and in one location, great rhododendron (*Rhododendron maximum*), Piedmont rhododendron (*R. minus*), and mountain laurel (*Kalmia latifolia*) (Duke 2009c; Nelson 1986; SCDNR 2005). The mixed hardwood herbaceous layer is occupied by Japanese honeysuckle (*Lonicera japonica*), an introduced species that is considered invasive and a severe threat (i.e., spreads easily into native plant communities and displaces native vegetation) in much of the southern and eastern United States (Dillenburg et al. 1993, White and Govus 2005), and Piedmont heartleaf (*Hexastylis minor*) (Duke 2009c).

Duke (2009c) described the steep, rocky bluffs on the west side of the Broad River as supporting a mixture of oaks, with white oak dominant, followed by tulip poplar, and shortleaf pine. Dogwood and sourwood (*Oxydendrum arboreum*) occupy the subcanopy, along with dense thickets of great rhododendron, Piedmont rhododendron, wild azalea (*R. nudiflorum*), and mountain laurel. The herbaceous layer consists of pipsissewa (*Chimaphila umbellata*), partridgeberry (*Mitchella repens*), Piedmont heartleaf, and mayapple (*Podophyllum peltatum*), with silverbell (*Halesia carolina*) and cane thickets present at the base of the bluffs along the river.

Mixed forests dominated by young to mid-age chestnut oak occur on the northwestern side of McKowns Mountain on dry, rocky soils. The lower slopes near Make-Up Pond B have tulip poplar, red oak, white oak, and beech (*Fagus spp.*) making up more of the canopy, with dogwood and ironwood (*Carpinus carolianiana*) in the subcanopy layer. Widely scattered

Piedmont heartleaf, American hepatica (*Hepatica americana*), Christmas fern (*Polystichum acrostichoides*), rattlesnake plantain (*Goodyera pubescens*), black-edged sedge (*Carex nigromarginata*) and whip nutrush (*Scleria triglomerata*) occur in the herbaceous layer (Duke 2009c).

The ravines that form the backwaters of Make-Up Pond B were described by Duke (2009c) as being dominated by American beech (*Fagus grandifolia*), tulip poplar, white oak, red oak, and white ash. Mountain laurel occurs in the shrub layer, and pipsissewa, partridgeberry, Piedmont heartleaf, and black-edged sedge are common in the herbaceous layer (Duke 2009c). Similarly, Duke (2009c) describes small ravines in the southwestern corner of the Lee Nuclear Station site as having similar overstories, with the addition of chalk maple in the subcanopy, and an herbaceous layer of Christmas fern, mayapple, violet wood sorrel (*Oxalis violacea*), false Solomon's seal (*Maianthemum racemosum*), Solomon's seal (*Polygonatum biflorum*), rattlesnake fern (*Botrychium virginianum*), and Canada horsebalm (*Collinsonia canadensis*). These areas appear similar to the mesic mixed hardwood forest described by Nelson (1986).

<u>Mixed Hardwood-Pine</u>

The mixed hardwood-pine cover type occupies 312.12 ac (16.2 percent) of the Lee Nuclear Station site (Duke 2013d). These areas may be young second or third growth mixed hardwood forests, such as oak-hickory that now have a significant pine component (NatureServe Explorer 2010). Duke indicated that the northwestern portion of the site is occupied by cutover mixed hardwood-pine dominated by tulip poplar, white ash, and white oak, with mountain laurel and species such as Jack-in-the-pulpit (*Arisaema triphyllum*), Christmas fern, southern lady fern (*Athyrium filix-femina*), Piedmont heartleaf, black cohosh (*Cimicifuga spp.*), mayapple, sessile-leaved bellwort (*Uvularia sessilifolia*), false Solomon's seal, coastal plain sedge (*C. crebriflora*), reflexed sedge (*C. retroflexa*), and white-edged sedge (*C. debilis*) in the herbaceous layer (Duke 2009c) Some of the ravines near Make-Up Pond B are dominated by tulip poplar, sweet gum, red maple (*Acer rubrum*), and white oak growing with shortleaf and loblolly pine (Duke 2009c).

<u>Open/Field/Meadow</u>

Open areas, fields, and meadows occupy 441.17 ac (22.9 percent) of the Lee Nuclear Station site (Duke 2013d). The area partially developed for the unfinished Cherokee Nuclear Station remains a large open habitat because of periodic disturbances from land clearing, mowing, and grazing. This cover type also includes areas with bare soil; paved roadways and parking lots; abandoned building foundations; and patches of early successional annual and perennial grasses, forbs, shrubs, and abandoned agricultural fields and improved fescue pastures (Duke 2009c).

Open Pine-Mixed Hardwood

This cover type represents a successional stage subsequent to the open/field/meadow cover type. These areas are dominated by widely spaced loblolly pine. The shrub and herbaceous layers also are sparse, and consist of a mix of hardwood species including white oak, sweet gum, and red maple (Duke 2009c). The open pine-mixed hardwood cover type occupies 70.24 ac (3.6 percent) of the Lee Nuclear Station site (Duke 2013d).

Pine

The pine cover type occupies 17.41 ac (0.9 percent) of the Lee Nuclear Station site and includes some silvicultural stands that are dominated by loblolly pine with scattered shortleaf or Virginia pine (Duke 2009c, 2013d).

Pine-Mixed Hardwood

Duke describes this cover type as being dominated by loblolly and shortleaf pine with a mixture of hardwood species consisting of white oak, red oak, tulip poplar, sweet gum, and red maple (Duke 2009c). The pine-mixed hardwood cover type occurs as widespread scattered stands and occupies 228.51 ac (11.9 percent) of the Lee Nuclear Station site (Duke 2013d).

Upland Scrub

The upland scrub cover type, as defined by Duke (2009c), includes "… early successional pine-mixed hardwood stands, open, partially forested stands, and dwarfed forest species growing on poor soil." It occupies a total of 154.21 ac (approximately 8.0 percent) of the Lee Nuclear Station site (Duke 2013d), primarily around the edges of the previously disturbed core building area. Dominant species include loblolly pine, Virginia pine, eastern red cedar, sumac (*Rhus spp.*), blackberry (*Rubus spp.*) (Duke 2009c), and exotic lespedeza (*Lespedeza cuneata*), which is planted in disturbed areas as an erosion control measure (Miller 2003).

Wetlands, Streams and Floodplains

This subsection discusses the wetlands, streams, and floodplains on the Lee Nuclear Station site. Streams are discussed further in Section 2.4.2.1.

The USACE has identified 22 jurisdictional wetlands totaling 12.52 ac on the Lee Nuclear Station site (USACE 2013a). One jurisdictional wetland (0.03 ac) on the Lee Nuclear Station site abuts the Broad River (USACE 2013a) (Figure 2-13). This wetland is forested, with cottonwood, sycamore (*Platanus occidentalis*), sugarberry (*Celtis laevigata*), sweet gum, and green ash (*Fraxinus pennsylvanica*) as the dominant canopy species with box elder (*Acer negundo*), black willow (*Salix nigra*), and buttonbush (*Cephalanthus occidentalis*) in the understory. The herbaceous layer includes false nettle (*Boehmeria cylindrica*), river oats (*Chasmanthium latifolium*), and cane (Duke 2009c).

The other 21 jurisdictional wetlands, occupying approximately 12.49 ac, abut or are otherwise closely associated with Make-Up Ponds A and B, small stream channels, springs, and natural depressions on the Lee Nuclear Station site (USACE 2013a) (Figure 2-13). These areas are partially forested, with the canopy dominated by a mix of red maple, tulip poplar, sweet gum, and black willow. Ironwood and tag alder (*Alnus serrulata*) are present in the understory and shrub layer. Other understory species include cottonwood, box elder, buttonbush, swamp dogwood (*Cornus stricta*), and elderberry (*Sambucus canadensis*). The herbaceous layer is characterized by common needlerush (*Juncus roemerianus*), sedges (*Carex* spp.), and false nettle (Duke 2009c).

<u>Wetland Functional Assessment</u>. Duke conducted functional assessments for jurisdictional wetlands within the boundaries of its Department of the Army permit application area (Duke 2011h) according to the USACE Charleston District Guidelines (USACE 2010a) and the North Carolina Wetland Assessment Method (NCWAM 2010). These activities were performed to assess the wetland resource functions lost from proposed unavoidable impacts to waters of the United States that would result from the development of the Lee Nuclear Station and help determine mitigation credits required to offset the net loss of waters (wetlands, open waters, and streams) of the United States and their associated functional benefits. Functional assessments for wetlands are discussed in this section and functional assessments for open waters and streams are discussed in Section 2.4.2.1.

Jurisdictional wetlands were assessed in the field in April and June 2011, based on three major functions and ten subfunctions: hydrology (surface storage and retention and subsurface storage and retention), water quality (pathogen change, particulate change, soluble change, physical change, and pollution change) and habitat (physical structure, landscape patch structure, and vegetation composition) and then compared to a reference wetland (NCWAM 2010). Functions and subfunctions were evaluated using 22 field metrics listed on a field assessment form. Scores for each of the functional descriptors were converted to give one of the four conditions: fully functional (functioning naturally as in an undisturbed condition), partially impaired (partial loss of functionality due to disturbance, but functional recovery is expected to occur through natural processes), impaired (partial loss of functionality due to disturbance which would require restoration activities to facilitate recovery), or very impaired (loss of most functionality due to disturbance and functional recovery would require a significant restoration effort).

Of the 22 wetland assessment areas on the Lee Nuclear Station site, 12 were classified as being fully functional, 6 were partially impaired, 2 were impaired, and 2 were very impaired (Duke 2011h).

Non-Jurisdictional Features

Eight non-jurisdictional features, total approximately 9.25 ac (USACE 2013a) (approximately 0.5 percent) of the Lee Nuclear Station site original project component boundaries (Table 2-7). Five of these developed in depressions surrounding the former locations for the unfinished Cherokee Nuclear Station reactors (Figure 2-13) and accumulate rainwater and runoff. Seasonal rainwater continues to be removed from the depressions. One of the other three features lies in a depression located northwest of the previous Cherokee Unit 1 containment structure (Figure 2-13). It is dominated by cottonwood, black willow, and common needlerush (Duke 2009c). The other two features are located just west of Make-Up Pond A (Figure 2-13).

Streams

About 3.9 mi of jurisdictional perennial and seasonal streams occur on the Lee Nuclear Station site and have hydrologic connections to the Broad River, the wetlands described above, and the open water areas, including Make-Up Ponds A and B (USACE 2013a).

Floodplains

Regulatory 100-year floodplains occur in low-lying areas of the Lee Nuclear Station site, primarily along the Broad River and in jurisdictional wetland areas around the margins of Make-Up Ponds A and B (Duke 2011h).

Wildlife

The wildlife observations noted below are primarily from three types of inventories carried out at the Lee Nuclear Station site. The first inventory involved intensive, quantitative, seasonal sampling of mammals, birds, and herpetofauna (amphibians and reptiles) conducted in each plant community onsite during 1973 and 1974 in support of the Cherokee Nuclear Station ER (Duke Power Company 1974a, b, c). The second inventory involved casual, anecdotal observations of mammals, birds, and herpetofauna made during pedestrian reconnaissance visits conducted in March, April, June, and October 2006 in support of the Lee Nuclear Station ER (Duke 2009c and Duke 2008e), and a cursory herpetological survey in 2007 (Dorcas 2007). The open/field/meadow and upland scrub cover types, and Make-Up Ponds B and A with their associated wetlands, described in the previous subsection did not exist and were thus not surveyed for mammals, birds, and herpetofauna from 1973 to 1974. In addition, it is likely that many wildlife species, particularly those that are more cryptic and/or are subject to time-of-day restrictions in detectability such as birds and herpetofauna, were not encountered during the 2006 reconnaissance visits or during the 2007 cursory herpetological survey. Consequently, a third type of wildlife inventory was conducted that involved collecting qualitative data sitewide on birds in 2009 (HDR/DTA 2009a) and herpetofauna (Dorcas 2009a) to determine their current distribution and abundance in support of the Lee Nuclear Station ER (Duke 2009c). These three types of inventories span the range from most intensive (the 1973 and 1974 quantitative studies) to least intensive (the 2006 anecdotal reconnaissance observations). Finally, when other anecdotal information about wildlife sightings onsite was available, that information also was incorporated.

Mammals

A total of 42 mammal species were considered as possibly occurring on the Cherokee Nuclear Station during 1973 and 1974, 20 (48 percent) of which were observed during field studies (Duke 2009c). Studies consisted of live-trapping and population estimation techniques for small and medium-sized mammals in each plant community onsite in December 1973 and April 1974 (Duke Power Company 1974a, b, c). The most common mammals observed during these studies were opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), eastern gray squirrel (*Sciurus carolinensis*), eastern fox squirrel (*S. niger*), eastern cottontail (*Sylvilagus floridanus*), and white-tailed deer (*Odocoileus virginianus*). All are considered year-long residents of the Lee Nuclear Station site (Duke 2009c). Most of these mammals were also observed during the 2006 surveys, as was beaver (*Castor canadensis*), which was not observed during surveys conducted during the mid-1970s (Duke 2009c).

A single white-tailed deer was observed onsite in the 1970s. Larger groups of two to six deer were observed during the 2006 field reconnaissance, suggesting that the species may be more abundant at the Lee Nuclear Station site than it was in the 1970s (Duke 2009c).

In South Carolina, black bears (*Ursus americanus*) traditionally occur in the mountains of Oconee, Pickens, Greenville, and Spartanburg Counties at the western edge of the state, but they appear to have been expanding their range and increasing in numbers over the past several decades (SCDNR 2005). Because Cherokee County is adjacent to and immediately east of Spartanburg County, black bears may be assumed to occur in the vicinity of the Lee Nuclear Station.

No small mammal trapping was conducted during the 2006 field reconnaissance. However, trapping in 1973 and 1974 (Duke Power Company 1974a, b, c) found numerous small mammal species, including rice rat (*Oryzomys palustris*), white-footed mouse (*Peromyscus leucopus*), short-tailed shrew (*Blarina brevicauda*), meadow vole (*Microtus pennsylvanicus*), and pine vole (*Pitymys pinetorum*) (Duke 2009c).

Birds

The Lee Nuclear Station site is situated along one of the principal inland routes of the Atlantic flyway (Bird and Nature 2009). The proposed site has potentially diverse avifauna, with 241 species considered as possibly occurring year-round based on known distributions in 1973 and 1974 (Duke 2009c). At that time, studies were conducted during all four seasons; these studies consisted of strip censuses to determine relative abundance and intensive plot censuses to determine breeding bird densities in each plant community onsite (Duke Power Company 1974a, b, c). Of the 77 possible water-dependent species, only 14 (18 percent) were observed in 1973 and 1974. Of the 164 possible upland species, 90 (55 percent) were observed in 1973 and 1974.

Since the 1970s, the creation of Make-Up Ponds A and B and Hold-Up Pond A has increased open water and wetland habitat on the Lee Nuclear Station site. Thus, it is likely that water-dependent birds are now more common onsite than in the 1970s (Duke 2009c). In addition, the open/field/meadow and upland scrub cover types did not exist onsite in the early 1970s before construction of the unfinished Cherokee Nuclear Station (Duke Power Company 1974a, b, c), and thus birds that use these habitats may currently occur onsite. Consequently, wetland/open water habitat, as well as open/field/meadow, upland scrub, mixed hardwood forest, and mixed pine/hardwood forest were intensively surveyed in May and June of 2009 using transect and point count censuses for spring migrants and resident breeding birds (HDR/DTA 2009a).

Based on information from field guides, breeding bird surveys in the vicinity (i.e., London Creek in support of proposed Make-Up Pond C and the North American Breeding Bird Survey Results and Analysis from 1966 to 2007, [Chesnee, SC route], regional and State bird lists, and the South Carolina Breeding Bird Atlas, 108 bird species could potentially breed in the vicinity of the Lee Nuclear Station. A total of 102 avian species were observed during the 2009 surveys, 19 of which are water-dependent, which is significantly more than the number of water-dependent species observed in 1973 and 1974 (Duke 2009c) considering that fall migrants and winter residents were not surveyed in 2009. A total of 70 of the 102 species were assumed to be breeding on or in the vicinity of the Lee Nuclear Station because they were present during the June 2009 survey (HDR/DTA 2009a). The most species-rich habitats included riparian, wetland, and bottomland hardwood forest associated with any of the open water areas on, or adjacent to, the Lee Nuclear Station site (HDR/DTA 2009a). The 2009 bird survey locations are provided in HDR/DTA (2009a).

The 2009 spring migrant/summer breeding (HDR/DTA 2009a) and 1973 and 1974 year-long (Duke Power Company 1974a, b, c) survey information is applied below to describe groups of bird species that occur on and in the vicinity of the proposed Lee Nuclear Station.

<u>Waterfowl</u>. The mallard duck (*Anas platyrhynchos*) and wood duck (*Aix sponsa*) were the only waterfowl species observed on or in the vicinity of the site in 1973 and 1974 (Duke 2009c). These species, along with the Canada goose (*Branta canadensis*), were also observed during the migrant/breeding bird surveys of 2009 (HDR/DTA 2009a). These three species are assumed to nest on or in the near vicinity of the Lee Nuclear Station site (HDR/DTA 2009a).

<u>Shorebirds</u>. Only 10 percent of the shorebirds (i.e., 2 of 21) considered as possible year-round residents at the site were observed during the 1973 and 1974 surveys: the killdeer (*Charadrius vociferus*) and the spotted sandpiper (*Actitis macularius*) (Duke 2009c). These two species,

plus six additional shorebird species, were observed during the migrant/breeding bird surveys of 2009 (HDR/DTA 2009a). However, only the killdeer is believed to nest on or in the near vicinity of the Lee Nuclear Station site (HDR/DTA 2009a). Cleared and open areas of the Lee Nuclear Station site provide suitable habitat for killdeer, which is typically found in fields and pastures, often far from water (Duke 2009c).

Colonial-Nesting Waterbirds. Only 26 percent of the colonial-nesting waterbirds (i.e., 5 of 19) considered to be possible year-round residents at the site were observed there during 1973 and 1974: herring gull (*Larus argentatus*), ring-billed gull (*Larus delawarensis*), great blue heron (*Ardea herodias*), little blue heron (*Egretta caerulea*), and green heron (*Butorides virescens*). No nesting colonies of any of these species were found at that time on or in the vicinity of the Cherokee Nuclear Station site (Duke 2009c). The great blue heron, green heron, and double-crested cormorant (*Phalacrocorax auritus*) were observed during the migrant/breeding bird surveys of 2009 (HDR/DTA 2009a). However, only the great blue heron and green heron are believed to nest on or in the vicinity of the Lee Nuclear Station (HDR/DTA 2009a).

Upland Game Birds. Four species of upland game birds were considered to be possible onsite residents during 1973 and 1974: wild turkey (*Meleagris gallopavo*), northern bobwhite quail (*Colinus virginianus*), American woodcock (*Scolopax minor*), and common snipe (*Gallinago gallinago*). Wilson's snipe (*G. delicata*), mourning dove (*Zenaida macroura*), rock dove (*Columba livia*), northern bobwhite quail, and wild turkey were observed during the migrant/breeding bird surveys of 2009 (HDR/DTA 2009a). However, only the mourning dove, rock dove, and wild turkey are believed to nest on or in the vicinity of the Lee Nuclear Station (HDR/DTA 2009a). The northern bobwhite quail was absent during the June 2009 survey; however, it could nest on or in the near vicinity of the Lee Nuclear Station, as it is considered a year-round resident throughout the southeastern United States (Kaufman 2000).

Perching Birds. Approximately 52 percent of the perching birds (i.e., 65 of 125) with the potential to occur at the unfinished Cherokee Nuclear Station were observed during the 1973 and 1974 surveys (Duke 2009c). The site still offers a variety of upland habitats; thus, most species observed in 1973 and 1974 probably still occur there. About 70 species of perching birds were observed during the migrant/breeding bird surveys of 2009, and about 50 of those species are believed to nest on or in the vicinity of the Lee Nuclear Station (HDR/DTA 2009a). Perching birds may be resident breeders, stop-over migrants that breed further north, or year-long residents. Year-long residents include eastern phoebe (*Sayornis phoebe*), blue jay (*Cyanocitta cristata*), Carolina chickadee (*Poecile carolinensis*), tufted titmouse (*Baeolophus bicolor*), Carolina wren (*Thryothorus ludovicianus*), mockingbird (*Mimus polyglottos*), American robin (*Turdus migratorius*), eastern bluebird (*Sialia sialis*), and cardinal (*Cardinalis cardinalis*) (Duke 2009c).

Birds of Prey. Approximately 52 percent of the birds of prey (i.e., 11 of 21) potentially occurring at the site were observed during the 1973 and 1974 surveys. Open habitats at the site provide suitable hunting-scavenging areas, and adjacent forest stands offer nesting habitat. Thus, most species observed there during 1973 and 1974 probably still occur there. Seven birds of prey were observed during the migrant/breeding bird surveys of 2009, and five of those species are believed to nest on or in the near vicinity of the Lee Nuclear Station: black vulture (*Coragyps atratus*), osprey (*Pandion haliaetus*), turkey vulture (*Cathartes aura*), red-shouldered hawk (*Buteo lineatus*), and red-tailed hawk (*Buteo jamaicensis*) (HDR/DTA 2009a). All of these species are non-migratory habitat generalists, and most take live prey such as other birds and small mammals. Some (e.g., vultures) are also scavengers. The osprey is a piscivore and nests along the western edge of Make-Up Pond A (Duke 2009c).

<u>Woodpeckers</u>. The prevalence of upland forests at the Lee Nuclear Station site is reflected in the number of woodpecker species inhabiting the site. Six of the eight woodpecker species that possibly occur at the site were observed there during 1973 and 1974 (Duke 2009c). Four woodpecker species were observed during the migrant/breeding bird surveys of 2009, and three of those species are believed to nest on or in the vicinity of the Lee Nuclear Station site (HDR/DTA 2009a). These include the downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), and red-bellied woodpecker (*Melanerpes carolinus*). In addition, the pileated woodpecker (*Dryocopus pileatus*), also observed in the migrant/breeding bird surveys of 2009, probably nests on or in the near vicinity of the Lee Nuclear Station site, as it is considered a year-round resident throughout much of the southeastern United States (Kaufman 2000). Woodpeckers are mainly non-migratory in the Carolina Piedmont (Kaufman 2000).

<u>Amphibians and Reptiles</u>

During the periods May 19-21, 1974, and August 12-13, 1974, intensive visual surveys for reptiles and amphibians were conducted in 1-ac plots within forest stands representative of each of seven bottomland and upland plant communities existing on the Cherokee Nuclear Station site at that time. In total, 16 amphibian and 17 reptile species were observed (Duke Power Company 1974a, b, c).

Since the 1970s, the creation of Make-Up Ponds A and B and Hold-Up Pond A has increased open water and wetland habitat on the Lee Nuclear Station site. Thus, anecdotal observations of reptiles and amphibians were made during the 2006 reconnaissance visits (Duke 2009c). In addition, on November 7, 2007, wetland habitats along the margins of Make-Up Ponds B and A were searched for amphibians and reptiles by boat with binoculars, turning over objects on land and in shallow water, and dipnetting streams and small pools. Five amphibian and four reptile species were documented. The low number of amphibian and reptile species identified during the November 7, 2007, survey may have been due to the time of year (i.e., fall as opposed to spring), the drought experienced in the southeastern United States in the summer and fall of 2007, and the short duration of sampling (Dorcas 2007). The 2007 herpetofauna survey locations also are documented by Dorcas (2007).

Consequently, between February and July 2009, extensive trapping and manual sampling (101 person days) was conducted in aquatic habitats, and less intensive sampling was conducted in terrestrial habitats (Dorcas 2009a). Turtle and minnow traps were used in open water and nighttime call surveys were conducted at significant amphibian breeding sites, in addition to the survey methods employed in 2007. The 2009 herpetofauna survey locations were documented by Dorcas (2009a). Based on queries of 47 museums, universities, and other appropriate organizations, and known geographic ranges and available habitat, a total of 66 species potentially could occur on and in the vicinity of the Lee Nuclear Station site (Dorcas 2009a). A total of 35 species of amphibians and reptiles, including 13 frog and toad species, 9 salamander species, 7 turtle species, 3 lizard species, and 3 snake species, were documented in 1974, 2007, and 2009. A high number of amphibians and reptiles were observed, especially those that are semi-aquatic (i.e., amphibians and turtles). This is likely due to the abundance and variety of lentic wetlands and ephemeral pools onsite (Dorcas 2009a).

Information from surveys conducted during 1974, 2007, and 2009 (Duke Power Company 1974a, b, c; Dorcas 2007, 2009a) is used below to describe herpetofauna species on and in the vicinity of the Lee Nuclear Station site.

Frogs and Toads. The frogs and toads of the Lee Nuclear Station site range from fully aquatic (e.g., bullfrog [*Rana catesbeiana*]) to semi-aquatic (e.g., toad species, treefrogs) in their habits. A total of 13 species of frogs and toads were observed during the surveys conducted in 1974, 2007, and 2009: (1) northern cricket frog (*Acris crepitans*), (2) Cope's gray treefrog (*Hyla chrysoscelis*), (3) green treefrog (*H. cinerea*), (4) spring peeper (*Pseudacris crucifer*), (5) upland chorus frog (*P. feriarum*), (6) green frog (*Rana clamitans*), (7) pickerel frog (*Rana palustris*), (8) Southern leopard frog (*R. sphenocephala*), (9) bullfrog, (10) American toad (*Bufo americanus*), (11) Fowler's toad (*B. fowleri*), (12) eastern narrowmouth toad (*Gastrophryne carolinensis*), and (13) eastern spadefoot toad (*Scaphiopus holbrookii*). The 12 species observed in 2009 (all of the above species except the Eastern spadefoot toad [Duke Power Company 1974a, b, c]) range from common (observed three to seven times in the 2007/2009 surveys) to abundant (observed eight or more times in the 2007/2009 surveys) (Dorcas 2009a). All 13 species are closely tied to water habitats (e.g., wetlands, temporary pools, and low-gradient streams and rivers), where they reproduce. All the frog and toad species, except the bullfrog, also make extensive use of adjacent terrestrial habitats, such as forest, grassland, and cropland as juveniles and adults.

Salamanders and Newts. The salamanders and newts range from those that are fully aquatic (e.g., red-spotted newt [*Notophthalmus viridescens*]), to those that are semi-aquatic (e.g., all salamander species observed except the northern slimy salamander [*Plethodon glutinosus*]), to completely terrestrial (e.g., slimy salamander) in their habits. Nine salamander and newt species were observed during surveys conducted in 1974, 2007, and 2009: (1) spotted salamander (*Ambystoma maculatum*), (2) marbled salamander (*A. opacum*), (3) northern dusky salamander (*Desmognathus fuscus*), (4) three-lined salamander (*Eurycea guttolineata*),

(5) Atlantic Coast slimy salamander (*Plethodon chlorobryonis*), (6) northern red salamander (*P. ruber*), (7) southern two-lined salamander (*Eurycea bislineata cirrigera*), (8) the northern slimy salamander, and (9) the red-spotted newt. Of the six salamander/newt species observed in 2009, only the spotted salamander and red-spotted newt were considered common; all others were considered somewhat rare (two observations) to rare (one observation) (Dorcas 2009a). The semi-aquatic salamanders and fully aquatic newt are closely tied to water such as trickling streams and wetlands where they reproduce. The adult semi-aquatic salamanders also utilize adjacent terrestrial habitat such as forests and grasslands, as do both larval and adult life stages of the fully terrestrial northern slimy salamander.

<u>Turtles</u>. The turtle species inhabit aquatic habitats ranging from rivers and streams to still-water habitats such as wetlands. The lifestyles of these turtles range from mostly aquatic (e.g., common snapping turtle [*Chelydra serpentina*]) to semi-aquatic (all the other turtle species). Nine turtle species were observed during surveys conducted in 1974, 2007, and 2009: (1) painted turtle (*Chrysemys picta*), (2) eastern mud turtle (*Kinosternon subrubrum*), (3) eastern river cooter (*Pseudemys concinna*), (4) common musk turtle (*Sternotherus odoratus*), (5) eastern box turtle (*Terrapene carolina*), (6) yellow-bellied slider (*Trachemys scripta*), (7) Gulf Coast spiny softshell (*Apalone spinifera aspera*), and (8) the snapping turtle. The seven species observed in 2009 (all of the species listed above except the Gulf Coast spiny softshell [Duke Power Company 1974a, b, c]) ranged from abundant to rare (Dorcas 2009a). All of the turtle species leave the water to nest and to bask. Nesting (egg deposition) is accomplished in soft substrates near water. Hibernation/burrowing during inactive periods may occur in soft soil or in fallen logs/debris, soft substrates under water, or under rocks or in holes in banks, depending on the species and habitat availability.

<u>Lizards</u>. The lizard species range from mostly arboreal (e.g., green anole [*Anolis carolinensis*]) to terrestrial (e.g., ground skink [*Scincella lateralis*]). Four lizard species were observed during surveys conducted in 1974, 2007, and 2009: (1) fence lizard (*Sceloporus undulatus*), (2) six-lined racerunner (*Aspidoscelis sexlineata*), (3) green anole, and (4) ground skink. The three species observed in 2009 (all of the species listed above except the six-lined racerunner [Duke Power Company 1974a, b, c]) ranged from common to rare (Dorcas 2009a). All the lizard species inhabit upland habitats, but may be found in upland areas near wetland or other aquatic habitats, although they have no particular affinity for aquatic habitats. All the lizard species spend periods of inactivity underground or in crevices, and they deposit eggs in soil, litter, or debris.

<u>Snakes</u>. The snake species range from mostly aquatic (e.g., northern watersnake [*Nerodia sipedon*]), to having an affinity for terrestrial habitats near water (e.g., rough greensnake [*Opheodrys aestivus*]), to having no apparent affinity for water or terrestrial habitats near water (all the other snake species subsequently listed). Seven snake species were observed during surveys conducted in 1974, 2007, and 2009: (1) smooth earthsnake (*Virginia valeriae*), (2) ringneck snake (*Diadophis punctatus*), (3) northern black racer (*Coluber constrictor*),

(4) coachwhip (*Masticophis flagellum*), (5) black rat snake (*Elaphe obsoleta*), (6) northern watersnake, and (7) rough greensnake. The three species observed in 2009 (i.e., black racer, rat snake, and watersnake [Duke Power Company 1974a, b, c]) ranged from common to rare (Dorcas 2009a). All the snake species spend periods of inactivity underground or in crevices or burrows and deposit eggs in soil, litter, debris, or abandoned mammal burrows.

2.4.1.2 Terrestrial Resources − Make-Up Pond C Site

Make-Up Pond C would be located in the London Creek watershed just northwest of the Lee Nuclear Station (Figure 2-14). Make-Up Pond C would have a surface area of approximately 620 ac and a drainage area of approximately 2500 ac (approximately 3.9 mi^2) (Duke 2009b, 2011h).

The Make-Up Pond C study area was delineated to define the boundaries within which related environmental data would be collected. The study area includes the following features (Duke 2009b, 2011h):

- Make-Up Pond C.
- a 300-ft buffer around the perimeter (Figure 2-14).
- Make-Up Pond C intake and refill structures and an associated 225-ft-long bridge extending from the shore, and pipelines that would transport water from the Broad River to Make-Up Pond C and between Make-Up Pond B and Make-Up Pond C.
- a plan to use an overhead 44-kV transmission line to power the Make-Up Pond C intake/refill structure has been eliminated. Instead, the Make-Up Pond C intake/refill structure will be powered with underground cables from the Lee Nuclear Station that will be routed below ground within the area of disturbance for the raw water service (RWS) pipeline (Duke 2013d).
- a realignment area for SC 329.
- an expansion area for the box culvert at the railroad crossing on London Creek.
- a realignment area for an existing 44-kV transmission line (The existing transmission line is currently out of service and is not needed at this time. Thus, only the corridor will be realigned [Duke 2011h].)
- improvements to Lake Cherokee Dam.

Existing cover types in the proposed Make-Up Pond C area are shown in Figure 2-14; jurisdictional open waters, wetlands, and streams, and non-jurisdictional features are shown in Figure 2-15. Acreages for the existing cover types are given in Table 2-8. Existing cover types, wetlands, streams, and floodplains, as well as mammals, birds, amphibians, and reptiles found in the cover types, are described below.

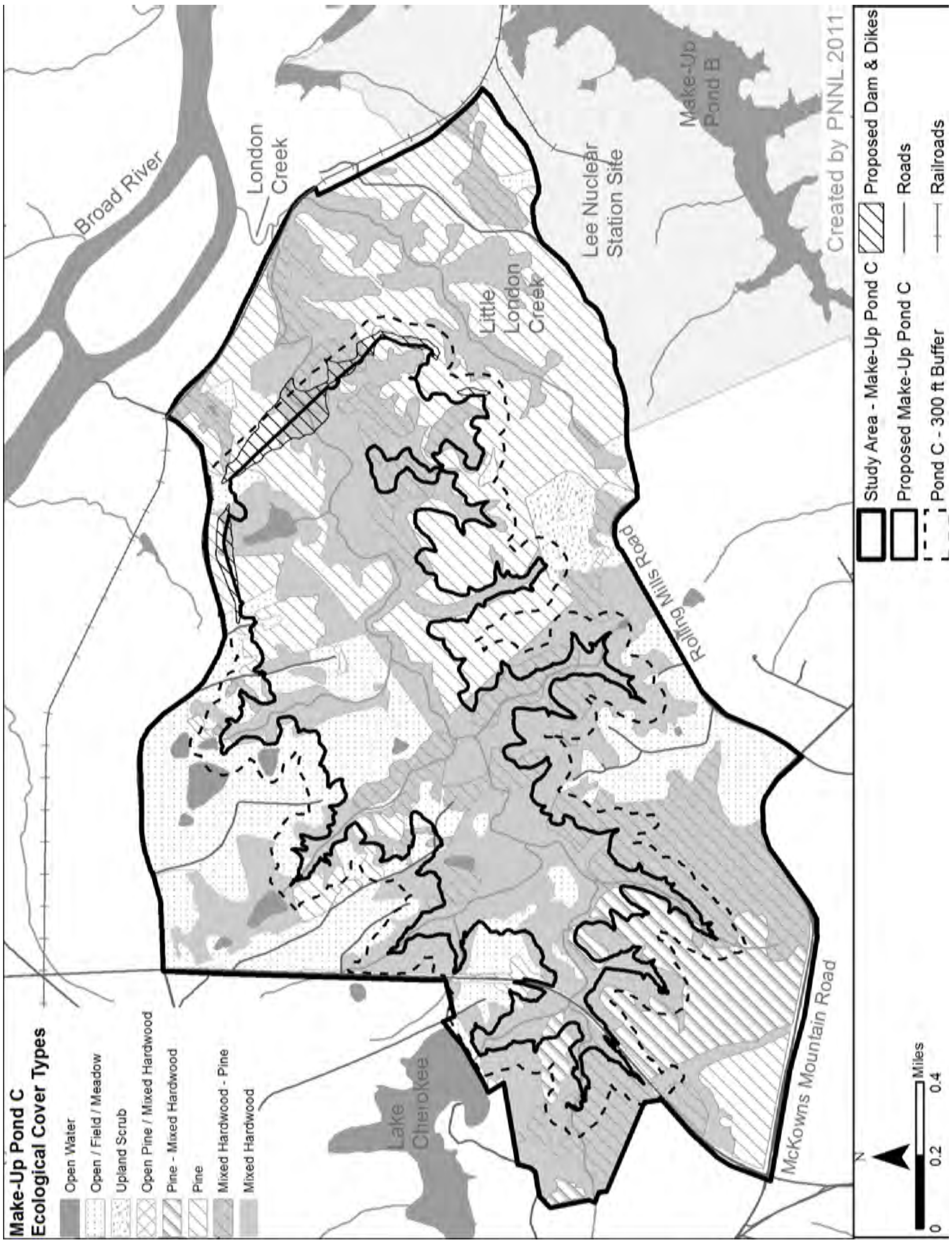

Figure 2-14. Ecological Cover Types in the Proposed Make-Up Pond C Study Area

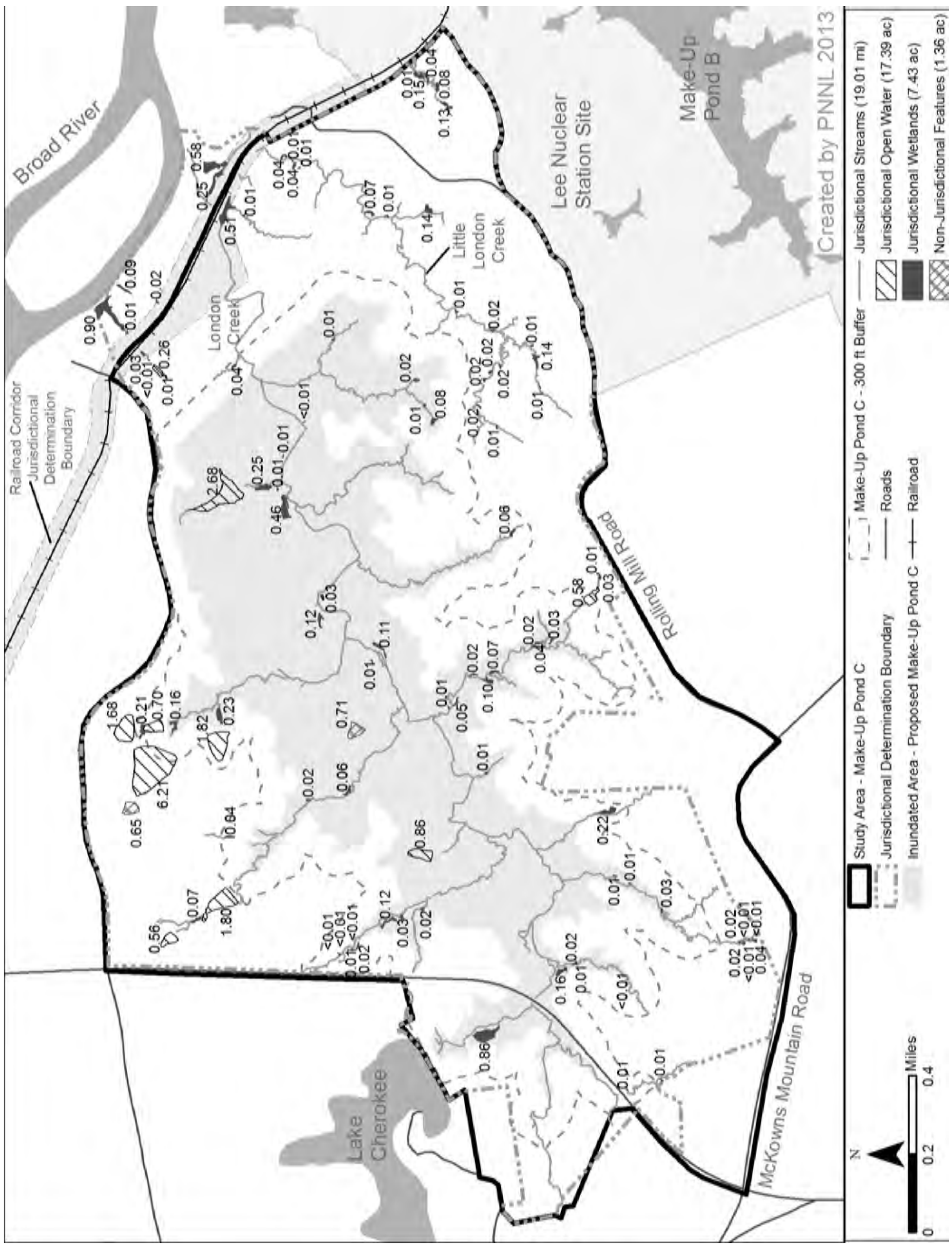

Figure 2-15. Wetlands and Waterbodies within USACE Jurisdictional Boundaries at the Proposed Make-Up Pond C (acreages for jurisdictional wetlands, jurisdictional waterbodies, and non-jurisdictional features obtained from the USACE [2013a])

Table 2-8. Acreages Occupied by Various Cover Types at the Proposed Make-Up Pond C

Coverage Type	Brief Description	Area (ac)	Percent of Total
Mixed hardwood	Stands dominated by mixed hardwood with little or no pine in the canopy	664.8	31.5
Pine	Pine stands/pine plantations with no or limited hardwoods in canopy	515.0	24.4
Open/field/meadow	Non-forested areas dominated by grasses, herbs, etc.; maintained by cattle grazing, mowing, and/or other vegetation management, past or present	426.6	20.2
Mixed hardwood-pine	Stands dominated by mixed hardwood with pine in the canopy	335.9	15.9
Pine-mixed hardwood	Stands dominated by pine with mixed hardwood in the canopy and understory	119.6	5.7
Upland scrub	Partially forested, early successional scrubby areas, including cutover areas lacking forest canopy development	28.0	1.3
Open water[(a)]	Reservoirs and ponds (farm ponds)	20.1	1.0
Open pine/mixed hardwood	Selectively cut stands with scattered pine in canopy and mixed hardwood understory	0.3	<0.1
	Total	**2110.3**	**100**

Source: Duke 2009b

(a) Open water cover type acreages were derived using aerial photo interpretation. Open waters were subsequently surveyed in the field during the jurisdictional determination (USACE 2013a), resulting in a more accurate acreage estimate of 17.39 ac for jurisdictional open waters and 1.36 ac for non-jurisdictional features (farm ponds excavated from uplands (Duke 2013d).

Existing Cover Types

A study of the vegetation of the Make-Up Pond C study area began in January 2008 and continued until October 2009 (Gaddy 2009). The study area was surveyed by vehicle and on foot. Vegetation was quantitatively sampled in 42 plots. Forty of these plots were circular 0.10-ac plots located in forested or mostly forested areas. Two plots were located in a non-forested transmission-line corridor, where each plot consisted of a cluster of five 4-m^2 subplots. A total of 426 species of plants were identified within the study area. Duke developed a vegetation cover map using 2006 false color infrared imagery, which was ground-truthed at the sample plots and at various other points in the study area (Gaddy 2009). Vegetation cover types found in the Make-Up Pond C study area are shown in Figure 2-14. Vegetation cover types are representative of several broader natural community types described by Nelson (1986) and SCDNR (2005) for the State of South Carolina.

Mixed Hardwood

Mixed hardwood communities within the Make-Up Pond C study area are similar to those found within the Lee Nuclear Station site. Duke estimated that this cover type occupies 664.8 ac or 31.5 percent of the Make-Up Pond C study area. Within the mixed hardwood classification, Duke identified four subtypes: upper and mid-slope mixed hardwood, cutover mixed hardwood, bluff mixed hardwood, and lowland mixed hardwood forest (Duke 2009b).

Upper and mid-slope mixed hardwood forest is found on mesic upland slopes and is mostly dominated by white oak, with American beech, tulip poplar, sweet gum, red oak, and red maple as co-dominant species. Sourwood, American holly, and ironwood are common species in the understory (Duke 2009b).

Partial recovery following timber harvesting or other disturbances within upper and mid-slope mixed hardwood forests and the mixed hardwood-pine or pine-mixed hardwood cover types results in the cutover mixed hardwood subtype, which occurs throughout the Make-Up Pond C study area (Duke 2009b). These communities are dominated by a mix of hardwood species such as tulip poplar, red maple, red oak, white oak, sweet gum, and hickories (*Carya* spp.).

Relatively undisturbed hillsides with steep faces along London Creek contain bluff mixed hardwood stands. These plant communities include rocky heath bluffs with thickets of mountain laurel and Piedmont rhododendron with scattered sourwood stands. Also included in this subtype are species-rich, mixed hardwood stands on more gentle slopes that are dominated by American beech, white oak, red oak, tulip poplar, bitternut hickory (*Carya cordiformis*), sourwood, and mountain laurel. Some of the trees in these stands are relatively large (e.g., 30- to 40-in. diameter breast high (DBH) (Duke 2009b; Nelson 1986; SCDNR 2005).

Lowland mixed hardwood forest occurs extensively on lower slopes, in riparian and seepage areas, and in bottomlands along London Creek and its tributaries, and along Little London Creek. These stands include elements of the bottomland hardwood forest and Piedmont seepage forest communities as described by Nelson (1986). Bottomland hardwood forest that occurs in the narrow floodplains of small Piedmont streams is known collectively as Piedmont small stream forest by the SCDNR and is targeted for conservation in South Carolina (SCDNR 2005). Bottomland hardwood forest is also one of several Piedmont floodplain community types targeted for conservation in the Piedmont of North Carolina (NCWRC 2005). A variety of species, such as sweet gum, American beech, tulip poplar, red maple, black walnut (*Juglans nigra*), green ash, American elm (*Ulmus americana*), and white ash are often present with giant cane, pawpaw, and strawberry bush (*Euonymus* spp.) listed as shrub layer dominants. The London Creek floodplain near the Broad River is dominated by cottonwood and sycamore. Large trees (30- to 40-in. DBH) are present. Forbs, such as mayapple and Jack-in-the-pulpit, occur in the herbaceous layer (Duke 2009b).

Mixed Hardwood-Pine

Mixed hardwood-pine forest dominated by white oak, red oak, sweet gum, and tulip poplar occurs on lower slopes and in transitional areas between pine-mixed hardwood and mixed hardwood cover types (Duke 2009b). The mixed hardwood-pine cover type occupies 335.9 ac (15.9 percent) of the Make-Up Pond C study area.

Open/Field/Meadow

This cover type consists of assemblages of herbaceous species that occur in residential areas, fields, pastures, and along roads and in transmission-line corridors (SCDNR 2005). It occupies 426.6 ac (20.2 percent) of the Make-Up Pond C study area. Dominant species in more xeric areas include little bluestem (*Schizachyrium scoparium*), broomsedge (*Andropogon virginicus*), purpletop (*Tridens flavus*), blackberry, fescue, goldenrod (*Solidago* spp.), asters (*Aster* spp.), sunflowers (*Helianthus* spp.), and plantains (*Plantago* spp.). More mesic species, such as skullcap (*Scutellaria integrifolia*), false indigo (*Baptisia alba*), and southern beardtongue (*Penstemon australis*), occur on more clayey soils. Giant cane, chaffseed (*Verbesina occidentalis*), and ironweed (*Vernonia noveboracensis*) are abundant in low-lying areas, while sedges, bulrushes (*Scirpus* spp.), and needlerush are present along streams. Pastures commonly support planted fescues (Duke 2009b).

Open Pine-Mixed Hardwood

Less than 0.1 percent (0.3 ac) of the Make-Up Pond C study area is characterized as open pine-mixed hardwood cover type (Duke 2009b).

Pine

As with the similar stands on the Lee Nuclear Station site, the pine cover type within the Make-Up Pond C study area consists primarily of stands of planted loblolly pine and scattered Virginia pine that are less than 50 years old. This cover type occupies 515.0 ac (24.4 percent) of the Make-Up Pond C study area. Understory vegetation is usually limited (Duke 2009b).

Pine-Mixed Hardwood

The pine-mixed hardwood cover type occupies 119.6 ac (5.7 percent) of the Make-Up Pond C study area. This community is a successional stage following disturbance within oak-hickory or other hardwood forest types. It is usually dominated by loblolly pine and Virginia pine, but early successional trees such as tulip poplar and sweet gum are common in the canopy as well as the understory (Duke 2009b; Nelson 1986).

Upland Scrub

The upland scrub cover type occupies 28.0 ac (1.3 percent) of the Make-Up Pond C study area. This type of community may develop following logging, especially in poor or erosion-prone soils. The trees in the communities that develop following logging may be stunted. Dominant species include eastern red cedar, Virginia pine, blackberry, and sumac (Duke 2009b).

Wetlands, Streams, and Floodplains

Make-Up Pond C would be located immediately downstream of Lake Cherokee, which is a 53-ac waterbody impounded in 1971 by Wildlife Dam on upper London Creek, a second-order stream. Lake Cherokee is the headwater of London Creek. Its drainage area is estimated at approximately 512 ac, which is included in the approximately 2500-ac drainage area upstream of the proposed Make-Up Pond C dam. London Creek flows approximately 3.76 mi from its head at Lake Cherokee to its confluence with the Broad River within the upper reaches of Ninety-Nine Islands Reservoir. Downstream of the proposed Make-Up Pond C dam, Little London Creek joins London Creek and their combined flow enters the Broad River (Duke 2009b, 2011h). London Creek and its tributaries, including Little London Creek, are the water sources for the numerous wetlands that occur in the Make-Up Pond C study area.

Jurisdictional Wetlands

Jurisdictional wetlands within the USACE jurisdictional determination boundary at the Make-Up Pond C site (Figure 2-15) were delineated in the field (Duke 2011h). These wetlands comprise a relatively small portion of the lowland mixed hardwood cover type, with a total area estimated to be 7.43 ac (USACE 2013a), or about 0.4 percent of the Make-Up Pond C study area.

The wetlands range in size from less than 0.01 to 0.90 ac; however, most are less than 0.10 ac (Figure 2-15), and are primarily associated with stream features (e.g., seepage areas, old beaver ponds, oxbow wetlands, and partially impounded streambeds) along London Creek, Little London Creek, and various unnamed tributaries (Figure 2-7) (Duke 2009b, 2011h). Dominant vegetation includes green ash, red maple, black willow, alder, cottonwood, and sycamore in the overstory, and common needlerush, sedges, and chain fern (*Woodwardia* spp.) in the herbaceous layer (Duke 2009b).

Wetland Functional Assessment

Duke performed functional assessments for jurisdictional wetlands in the Make-Up Pond C study area in the same manner as noted above for jurisdictional wetlands on the Lee Nuclear Station site (see Section 2.4.1.1). Of the 95 wetland assessment areas on the Make-Up Pond C site, 73 were classified as being fully functional, 15 were partially impaired, 4 were impaired, and 3 were very impaired (Duke 2011h).

Streams

About 19 mi of jurisdictional perennial and seasonal streams occur within the USACE jurisdictional determination boundary at the Make-Up Pond C site (USACE 2013a) and have hydrologic connections to the wetlands described above and to the Broad River (Duke 2009b, 2011h). These include London Creek and its tributaries (including Little London Creek) below Lake Cherokee (USACE 2013a). Tributary streams on the south side of London Creek generally have significant forested buffers, whereas tributary streams on the north side often lack forested buffers and are located in pasture areas (Duke 2011h).

Floodplains

Regulatory 100-year floodplains occur in low-lying areas of the Make-Up Pond C study area, along most of the mainstem of London Creek (Duke 2011h).

Significant Natural Areas

Ten locations were determined by the applicant to be “significant natural areas” based on the presence of rare plant communities, rare plant species, or mature to old-growth trees. These natural areas are generally small, ranging in size from around 0.5 ac (Chain Fern Bog) to just over 5 ac (London Creek Bottoms) (Gaddy 2009). Note that the numbering system for each sampling area approximates the mileage upstream from the confluence of London Creek with the Broad River.

Cinnamon Fern Bog

This is a seepage bog near the westernmost portion of sampling area 2.6 (Figure 2-16) dominated by green ash and tulip poplar with several dominant sedges (bent sedge [*Carex styloflexa*], thicket sedge [*C. abscondita*], prickly bog sedge [*C. atlantica*]) and a luxuriant fern flora with large cinnamon (*Osmunda cinnamomea*), royal (*O. regalis* var. *spectabilis*), and sensitive ferns (*Onoclea sensibilis*) (Gaddy 2009).

Laurel Ravine

This is a mountain laurel-dominated ravine just east of Cinnamon Fern Bog in sampling area 2.6. Extremely large mountain laurel up to 25 ft in height and with a main stem diameter over 4 in. are present (Gaddy 2009).

West Bluff

Just downstream from Laurel Ravine (in sampling area 2.6), a steep, north-facing bluff harbors a stand of mature red oak, bitternut hickory, and beech with trees up to 30- to 40-in. DBH. Large sourwood up to 11-in. DBH also are present (Gaddy 2009).

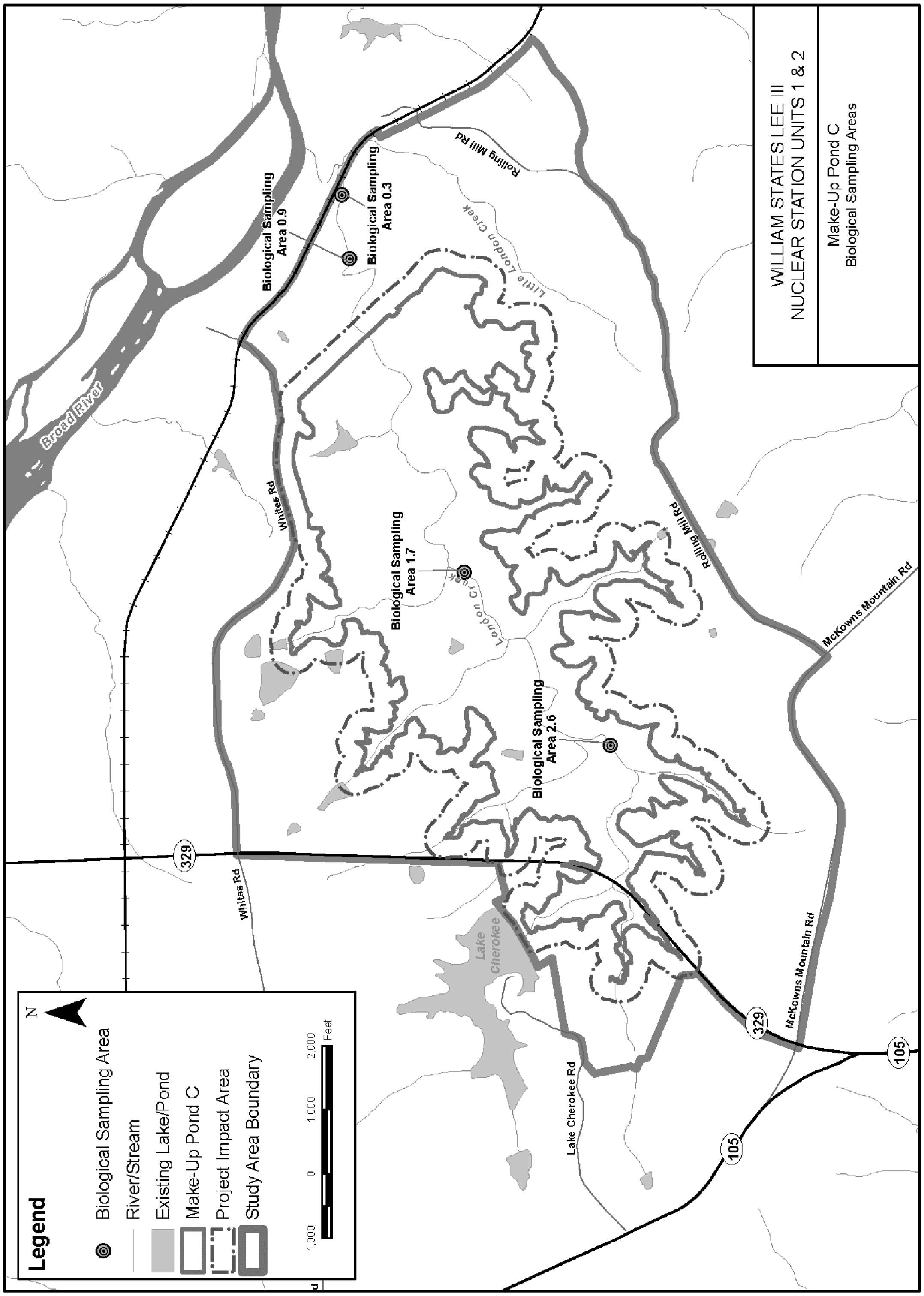

Figure 2-16. Survey Locations within Footprint of Make-Up Pond C (Duke 2009b)

West Bottoms

A rich bottomland with a diverse assemblage of species is found in sampling area 2.6 along London Creek. Black walnut, American elm, eastern red cedar, white ash, winged elm (*Ulmus alata*), tulip poplar, and sweet gum are present in the canopy. In the understory, redbud, pawpaw, and spicebush (*Lindera benzoin*) are common. In the herbaceous layer, two State-ranked species are present (i.e., southern adder's-tongue fern (*Ophioglossum vulgatum*) and drooping sedge [*Carex prasina*]; see Section 2.4.1.6), along with mayapple and Jack-in-the-pulpit (Gaddy 2009).

Sampling Area 1.7 and Adjacent Bluff

Sampling area 1.7 (Figure 2-16) and the adjacent bluff is a species-rich complex of forest and herbaceous species. The bluff is dominated by mature (up to 30-in. DBH) beech, tulip poplar, and bitternut hickory and overlooks a species-rich bottom. The bottom has black walnut, red maple, tulip poplar, American elm, and sweet gum in the canopy with three State-ranked plant species in the herbaceous layer (i.e., southern enchanter's nightshade [*Circaea lutetiana* ssp. *canadensis*], southern adder's-tongue fern, and single-flowered cancer root [*Orobanche uniflora]*) (see Section 2.4.1.6) (Gaddy 2009).

Rhododendron Bluff

Rhododendron Bluff overlooks lower London Creek at sampling area 0.9 (Figure 2-16). It is dominated by Piedmont rhododendron, mountain laurel, beech, sourwood, and American holly. Piedmont rhododendron, which is found in the Piedmont of Virginia and North Carolina, is rarely dominant on bluffs in the Piedmont of South Carolina. In South Carolina, this flowering shrub is usually a Blue Ridge species and is, thus, somewhat outside of its normal range at this location (Gaddy 2009).

London Creek Bottoms

London Creek enters the species-rich floodplain of the Broad River in the downstream portion of sampling area 0.3 (Figure 2-16). Large cottonwood (*Populus deltoides*) and sweet gum over 36-in. DBH dominate a mature forest that is more typical of larger floodplains. Mature sycamore, green ash, and American elm also are found in the canopy. The understory is open with scattered box elder. Yellowish milkweed vine (*Matalea flavidula*), known from only four counties in South Carolina and rare in the Piedmont, was found in the herbaceous layer (Gaddy 2009).

Little London Creek Bottoms

Little London Creek is located in the upper portion of sampling area 0.3. The Little London Creek ravine is rich in mature hardwood species, such as white oak, sweet gum, tulip poplar, water oak (*Quercus nigra*), beech, and black gum (*Nyssa sylvatica*). American holly is common in the understory with southern lady fern, Christmas fern, and partridgeberry common in the herbaceous layer (Gaddy 2009).

Fern Ravine

A ravine with a small rocky stream with waterfalls and slides enters London Creek upstream from sampling area 2.6. This pristine area is dominated by scattered mature beeches (up to 43-in. DBH) and tulip poplars. American holly is the dominant species in the understory, and broad beechfern (*Thelypteris hexagonoptera*) and maidenhair fern (*Adiantum pedatum*) are common along the creek (Gaddy 2009).

Chain Fern Bog

Chain Fern Bog is a small mucky seepage bog found adjacent to a small tributary of London Creek southeast of sampling area 2.6. Netted chain fern (*Woodwardia areolata*) is the dominant species. The canopy consists of scattered red maple and black gum, and highbush blueberry (*Vaccinium corymbosum*) is common in the understory. Other wetland plants include arrow arum (*Peltandra virginica*) and turtlehead (*Chelone obliqua*) (Gaddy 2009).

Noteworthy Ecological Associations

The basic unit for vegetation classification in the U.S. National Vegetation Classification (NVC) is the association. The NVC defines the association as "a vegetation classification unit defined on the basis of a characteristic range of species composition, diagnostic species occurrence, habitat conditions, and physiognomy [structural appearance]" (Jennings et al. 2009). Based on the botanical inventory of the Make-Up Pond C study area (Gaddy 2009) and observations made in the field in July 2010 by the SCDNR (SCDNR 2011b), four noteworthy ecological associations were preliminarily identified—three in the uplands of the Make-Up Pond C study area and one in the lowlands (SCDNR 2011b). Piedmont acidic mesic mixed hardwood forest, Piedmont beech/heath bluff, and Piedmont basic mesic mixed hardwood forest occur in the uplands. Piedmont streamside seepage swamp occurs in the lowlands (SCDNR 2011b).

It is uncertain whether these four ecological associations (SCDNR 2011b) co-occur with the significant natural areas (Gaddy 2009) or occur within the cover types previously described, as none was delineated in the field. It is also uncertain whether the significant natural areas are representative of the four ecological associations because the detailed floristic information that would be necessary to classify such areas as ecological associations per the U.S. National Vegetation Classification System is lacking (Duke 2012c). However, the four ecological associations and the significant natural areas share some prevalent plant species, as indicated in the descriptions presented in this section.

In addition, Gaddy (2009) noted the presence of giant cane in the Make-Up Pond C study area, and the SCDNR (2011b) referred to this as representing the floodplain canebrake ecological association. This discrepancy (Duke 2012c) is discussed in greater detail in the following paragraphs. Further, the SCDNR noted the presence of mountain-like cove habitats (small, well-developed hardwood forests usually on protected bluffs close to stream or river bottoms [SCDNR 2005]) created by steep rock formations (SCDNR 2010a, 2011b). Cove habitats are more typically associated with the higher elevations of the upper Piedmont (SCDNR 2010a) and further increase the biological diversity of the London Creek system, especially for the birds (SCDNR 2005, 2010f) and amphibians (SCDNR 2005) discussed below.

Piedmont acidic mesic mixed hardwood forest (American beech – northern red oak/flowering dogwood [*Cornus florida*]/Christmas fern – Virginia heartleaf [*Hexastylis virginica*] forest) (unique association identifier CEGL008465) is the most typical ecological association along ravines and coves in the Piedmont (SCDNR 2011b). Piedmont acidic mesic mixed hardwood forest communities are fairly common but are considered vulnerable (global conservation status rank of G3). Under natural conditions, these forests are uneven-aged, with old trees present (NatureServe Explorer 2010). Large-stature beech trees (dominant), red oak (prevalent), and flowering dogwood were observed in the West Bluff significant natural area in the Make-Up Pond C study area (Gaddy 2009). However, it is uncertain whether this location of mature beech trees represents or is associated with the Piedmont acidic mesic mixed hardwood forest community type observed by SCDNR (SCDNR 2011b).

The Piedmont beech/heath bluff (American beech – white oak/mountain laurel – common sweetleaf [*Symplocos tinctoria*], Catawba rosebay [*Rhododendron catawbiense*]/beetleweed [*Galax urceolata*] forest) (SCDNR 2011b) association (unique identifier CEGL004539) occurs on steep north-facing slopes in the lower Piedmont, and disjunct examples of this type are found in South Carolina. This association is considered imperiled (global conservation status rank of G2) (NatureServe Explorer 2010). Although Catawba rosebay was not documented in this community in the Make-Up Pond C study area, both Piedmont rhododendron and great rhododendron are present (SCDNR 2011b). Beech, white oak, and Piedmont rhododendron were observed in the Bluff Hardwoods significant natural area in the Make-Up Pond C study area (Gaddy 2009). However, it is uncertain whether this significant natural area represents or is associated with the Piedmont beech/heath bluff community type observed by the SCDNR (SCDNR 2011b).

The Piedmont basic mesic mixed hardwood forest (American beech – northern red oak/Florida maple [*Acer barbatum*] – painted buckeye [*Aesculus sylvatica*]/black baneberry [*Actaea racemosa*] – maidenhair fern forest) (SCDNR 2011b) association (unique identifier CEGL008466) represents intermediate and basic, mesic, mixed hardwood forests of the Piedmont and is considered vulnerable (global conservation status rank of G3) (NatureServe Explorer 2010). Beech and red oak are dominant in some parts of the bluff mixed hardwood forest community subtype (Gaddy 2009) described above. However, it is uncertain whether this community subtype represents or is associated with the Piedmont basic mesic mixed hardwood forest community type observed by the SCDNR (SCDNR 2011b).

Piedmont streamside seepage swamp (red maple [*Acer rubrum var. trilobum*] – tulip poplar/ American holly/cinnamon fern forest) (unique association identifier CEGL004551) vegetation is found in the southeastern Piedmont of North Carolina (NatureServe Explorer 2010), and undisturbed, extensive wetlands of this type are very limited in the Piedmont of South Carolina (SCDNR 2011b). This association is considered imperiled (global conservation status rank of G2) (NatureServe Explorer 2010). Tulip poplar is present in the overstory and cinnamon fern species in the understory of the Cinnamon Fern Bog significant natural area in the Make-Up Pond C study area (Gaddy 2009). However, it is uncertain whether this significant natural area represents or is associated with the Piedmont streamside seepage swamp community type observed by the SCDNR (SCDNR 2011b).

SCDNR (2011b), reporting on a reconnaissance-level survey of the Make-Up Pond C study area, cited the floodplain canebrake (giant cane shrubland) ecological association (unique association identifier CEGL003836 [NatureServe Explorer 2010]) as being present but not extensive. This floodplain canebrake ecological association is considered globally imperiled (global conservation status rank of G2) (NatureServe Explorer 2010). Gaddy (2009), reporting on a detailed botanical inventory of the Make-Up Pond C study area, noted that giant cane was prevalent in the understory at two locations in lowland mixed hardwood forest and mixed hardwood forest, where black walnut and sweet gum are prevalent, respectively, in the overstory; in low-lying areas of open/field/meadow habitat; and in scattered areas of lowland mixed hardwood forest as a shrub layer dominant in association with pawpaw and spicebush.

White (2004) describes the floodplain canebrake ecological association as follows:

> *This floodplain canebrake ecological association is characterized by dense, often monospecific thickets of the giant cane occupying large areas referred to as canebrakes. The canebrake shrubland type was historically widespread, but is now rare and occupies very little of its former acreage. It was best developed in streamside flats and alluvial floodplains on ridges and terraces where it was protected from prolonged inundation. Historically, this community covered large areas of many floodplains and streamsides in the Coastal Plain from North Carolina to Texas, Mississippi River Alluvial Plain, Interior Highlands, Interior Low Plateau, Southern Blue Ridge and possibly the Central Appalachians of the southeastern United States. Stands occur on alluvial and loess soils and are often associated with bottomland hardwood forest vegetation. This association is successional and is thought to be maintained by periodic fires and/or grazing. It may have originated following abandonment of aboriginal agricultural fields or other natural and anthropogenic disturbances such as blow-downs and catastrophic floods.*

The above statement is ambiguous as to whether just extensive monospecific thickets of giant cane, or extensive monospecific thickets of cane and stands of cane associated with bottomland hardwood forest comprise the floodplain canebrake ecological association.

Brantley and Platt (2001), in their discussion of minimum habitat standards for canebrake, raise the need for development of specific criteria to differentiate “canebrakes” (referring to the imperiled ecological association) from smaller areas of cane growing in the understory of other vegetative cover classifications, because the latter may provide the basis for restoration efforts of the former. In distinguishing the imperiled floodplain canebrake ecological association from cane growing in the understory of other vegetative cover, it is illustrative to consider the White (2004) floristic inventory and plant community classification of the Cowpens National Battlefield, located about 18 mi northwest of the Lee Nuclear Station site. Historical accounts from the time of the Revolutionary War describe extensive fields of cane along many of the creeks that today no longer exist within the park boundary. Canebrake is further described as being locally extinct in the area of Cowpens National Battlefield, although small populations of cane still exist in sparse patches throughout the park’s streamside forests (White 2004). Based on the above information, the review team concludes that the cane patches that occur in the understory of forested areas in the Make-Up Pond C study area do not represent the globally imperiled floodplain canebrake ecological association.

Rare Plant Species

Five rare or otherwise noteworthy (not Federally listed or State-ranked) plant species were observed in the Make-Up Pond C study area: (1) mountain holly (*Ilex montana*) and (2) golden ragwort (*Senecio aureus*), both rare outside of the Blue Ridge Mountains; (3) tuberous dwarf-dandelion (*Krigia dandelion*), widely scattered in the Piedmont of South Carolina; (4) yellowish milkweed vine, known from only four counties in South Carolina; and (5) Kral’s sedge (*Carex kraliana*), unreported in the South Carolina Plant Atlas (USC 2013) and possibly the second record for the State (Gaddy 2009).

Invasive Plant Species

Of the 426 plant species that were identified within the study area, 20 (about 5 percent) were exotic or invasive species (Gaddy 2009). However, the more common invasive plant species, such as Chinese privet (*Ligustrum sinense*), autumn olive (*Elaeagnus umbellata*), Japanese honeysuckle, and Vietnam grass (*Microstegium vimineum*), were present but uncommon in the Make-Up Pond C study area (Gaddy 2009). This may be because habitat/ground disturbance in the bottomlands of the Make-Up Pond C study area is relatively low compared to similar sites in the foothills of upstate South Carolina. The ridge tops have been disturbed mostly by silviculture, but the north-facing slopes (and bottomlands) have undergone relatively little disturbance (Duke 2011h, SCDNR 2011b). Chinese privet, Japanese honeysuckle, and

Vietnam grass are considered a severe threat, i.e., spreads easily into native plant communities and displaces native vegetation (White and Govus 2005).

Wildlife

The riparian corridor along London Creek provides habitat suitable for a wide variety of wildlife, including both game and non-game species representative of the Piedmont and foothills regions. Bottomland hardwood habitats and the adjacent areas provide vital travel corridors, feeding areas, and den sites for many of the wildlife species (SCDNR 2011b) discussed in this section.

Mammals

During 2008 and 2009, Duke employed a variety of techniques to survey the mammalian fauna of the Make-Up Pond C study area, including snap traps (1192 trap nights), live traps, and pitfall traps (7450 trap nights) for small mammals and field surveys to record mammal observations and field sign (e.g., tracks, scat, nests, dens) for small, medium, and large mammals. Sampling areas included most of the habitat types within the Make-Up Pond C study area, including mixed hardwood, mixed hardwood-pine, pine-mixed hardwood, open/field/meadow, and pine habitats. Bats were inventoried using mist nets for three nights along London Creek and nearby open habitats. In addition, bat vocalizations were recorded using an ANABAT ultrasonic detector. Other sampling was conducted via pedestrian field surveys to record mammal observations and sign throughout a variety of habitat types within the Make-Up Pond C study area (Duke 2009b; Webster 2009). Locations for mammal surveys undertaken in 2008 and 2009 are shown in Figure 1 in Webster (2009).

In the evaluation of the Make-Up Pond C study area, Webster (2009) identified 34 mammal species (33 native and one introduced) that could potentially occur based on major North American museum collections and a review of literature and other pertinent records for the locality. A total of 22 species were documented during the 2008 and 2009 field surveys (Webster 2009). Common mammal species typical of the region include Virginia opossum, eastern mole (*Scalopus aquaticus*), eastern red bat (*Lasiurus borealis*), eastern cottontail, eastern gray squirrel, coyote (*Canis latrans*), raccoon, white-tailed deer, eastern harvest mouse (*Reithrodontomys humulis*), and hispid cotton rat (*Sigmodon hispidus*) (Duke 2009b; Webster 2009).

Although some of the trapping success rates were relatively low for small mammals in the forested habitats, the small mammal density in early successional old field habitats was relatively high. The population densities of medium and large mammals within the Make-Up Pond C study area were similar to comparable habitats in the Piedmont (Duke 2009b; Webster 2009).

Birds

In 2008, DTA evaluated the breeding and migratory avifauna of the Make-Up Pond C study area by conducting field surveys during spring migration, the summer breeding season, and fall migration near the four main biological sampling areas (Figure 2-16) (DTA 2008b). Bird survey locations are provided in DTA (2008b). Mixed hardwood forest (mainly lowland mixed hardwood forest along London Creek), pine forest (mainly planted pine with some cutover successional forest), and open/field/meadow cover types were surveyed in a similar manner (Duke 2009b; DTA 2008b).

Based on general geographic distributions in the region, obtained by a review of literature and existing data records (i.e., field guides, State bird lists, and the compilation of the North American Breeding Bird Survey records [Chesnee, SC route] and Breeding Bird Atlas data from Cherokee County) a total of over 200 bird species could potentially occur within the Make-Up Pond C study area. Field surveys documented 87 bird species in the Make-Up Pond C study area, including 57 species known to breed in South Carolina and assumed to be breeding locally because of their seasonal occurrence. Of these 87 species, 30 are on either the South Carolina Comprehensive Wildlife Conservation Strategy (SCDNR 2005) or the regional Atlantic Coast Joint Venture (ACJV 2010) priority list (SCDNR 2011b), many of which are neotropical migrant songbirds.

The mixed pine-hardwood and bottomland hardwood habitats exhibited the greatest number of species. Duke (DTA 2008b) indicated that the most common bird species include turkey vulture, wild turkey, mourning dove, pileated woodpecker, red-bellied woodpecker, hairy woodpecker, downy woodpecker, barn swallow (*Hirundo rustica*), blue jay, American crow (*Corvus brachyrhynchos*), Carolina chickadee, tufted titmouse, white-breasted nuthatch (*Sitta carolinensis*), Carolina wren, northern mockingbird, American robin, eastern bluebird, blue-gray gnatcatcher (*Polioptila caerulea*), white-eyed vireo (*Vireo griseus*), red-eyed vireo (*V. olivaceous*), black-and-white warbler (*Mniotilta varia*), northern parula (*Parula americana*), pine warbler (*Dendroica pinus*), Louisiana waterthrush (*Seiurus motacilla*), common yellowthroat (*Geothlypis trichas*), yellow-breasted chat (*Icteria virens*), hooded warbler (*Wilsonia citrina*), eastern meadowlark (*Sturnella magna*), common grackle (*Quiscalus quiscula*), scarlet tanager (*Piranga olivacea*), northern cardinal, American goldfinch (*Carduelis tristis*), eastern towhee (*Pipilo erythrophthalmus*), and brown-headed cowbird (*Molothrus ater*).

Duke compared the Make-Up Pond C bird survey results with the North American Breeding Bird Survey (Chesnee, SC route) and found that the species richness and composition within the Make-Up Pond C study area appears to be typical for the region and habitat types present (Duke 2009b; DTA 2008b). The spring migration surveys had the highest species counts of any of the surveys and the bottomland hardwood forest along London Creek provided the highest quality avian habitat and species diversity. However, the bottomland habitat is narrow, degraded, and fragmented because of past and present land uses. Clearing of hardwood forests for pastureland and planting pine plantations has limited the amount of breeding habitat for birds. Thus, because of the extensive low-quality pine plantations and cultivated lands, lower diversity of avian species, and the reduced size and fragmentation of higher quality habitats (Duke 2009b; DTA 2008b), the London Creek area is considered to be relatively poor avian habitat.

Diversity of shorebirds was low, with only killdeer and American woodcock noted within the Make-Up Pond C study area. Great blue herons were the only colonial-nesting water birds observed, and no suitable heron nesting habitat was observed (DTA 2008b).

A number of upland game birds were observed, including wild turkey, northern bobwhite, American woodcock, mourning dove, and ruffed grouse (*Bonasa umbellus*). Wild turkeys were abundant in both mature woods and open areas. Northern bobwhite and mourning doves were observed in brushy areas, abandoned fields, and open pine forests. The woodcock was observed in lowland mixed hardwoods along London Creek. Ruffed grouse were observed onsite, but were not expected to occur in the Make-Up Pond C study area because the species is usually found in the mountains of South Carolina west of the Lee Nuclear Station (Duke 2009b). Areas near the edges and adjacent to the open land and pastures provide bugging sites and nesting and brood rearing habitat for species such as bobwhite quail and wild turkey (SCDNR 2011b).

Over 60 species of perching birds were observed in the Make-Up Pond C study area, and over 40 of these were assumed to be nesting within the study area. Migratory species that were observed included a number of neotropical migrants (Duke 2009b; DTA 2008b).

Relatively high numbers of migrant songbirds were observed (DTA 2008b). Migrants probably are using the forested stream corridor during migration when the connectivity of forested wetlands and stream systems is critical. Forested areas are used because they provide the highest density of food resources (SCDNR 2011b).

At least five species of woodpeckers were observed in the area, including the northern flicker (*Colaptes auratus*), pileated woodpecker, red-bellied woodpecker, hairy woodpecker, and downy woodpecker. Except for the northern flicker, these species are likely to nest within the Make-Up Pond C study area (Duke 2009b; DTA 2008b).

Several birds of prey species were assumed to be nesting in the Make-Up Pond C study area including turkey vulture, black vulture, red-tailed hawk, red-shouldered hawk, and great horned owl (*Bubo virginianus*) (Duke 2009b; DTA 2008b). Osprey and bald eagle (*Haliaeetus leucocephalus*) were also observed in the study area.

Amphibians and Reptiles

The herpetofauna of the Make-Up Pond C study area was investigated from January through October 2008 and from February through July 2009 via field sampling. Techniques employed included automated recording systems, systematic dip netting, minnow traps, turtle traps, pitfall traps, and visual and auditory (frog/toad call) field searches (Duke 2009b; Dorcas 2009b).

Field surveys were conducted at seven separate locations in the vicinity of the four biological sampling areas depicted in Figure 2-16. Various herpetofauna habitats were surveyed in and along London Creek and several of its tributaries, including stream pool and riffle areas, a beaver pond, wetlands, farm ponds, lowland mixed hardwood habitats, and upland habitats. Additional areas and habitat types were surveyed using visual and call searches (Duke 2009b; Dorcas 2009b). The 2009 herpetofauna sample locations are identified in Dorcas (2009b).

Based on published distributions and specimen records for Cherokee County obtained from museums, universities, and other appropriate organizations, 66 species (25 amphibian and 41 reptile) were determined to potentially occur within the Make-Up Pond C study area. Of these 66 potential species, 37 species, including 19 amphibian (76 percent of the potential species) and 18 reptile (43 percent of the potential species), were documented during the Make-Up Pond C study area field sampling (Dorcas 2009b). The most common species included northern cricket frog, Fowler's toad, Cope's gray treefrog, spring peeper, upland chorus frog, bullfrog, green frog, southern leopard frog, marbled salamander, northern dusky salamander, southern two-lined salamander, red-spotted newt, Atlantic Coast slimy salamander, eastern box turtle, green anole, six-lined racerunner, fence lizard, worm snake (*Carphophis amoenus*), black racer, ringneck snake, rat snake, northern watersnake, and copperhead (*Agkistrodon contortrix*) (Duke 2009b; Dorcas 2009b).

Primary aquatic habitats within the Piedmont are typically stream-based ecosystems often with associated farm ponds, beaver ponds, and floodplain wetlands, similar to London Creek. Based on the field surveys, the herpetofauna of London Creek and its environs is similar to the herpetofauna found throughout the Piedmont of the Carolinas. However, the London Creek herpetofauna is considered to be relatively diverse, likely resulting from diverse aquatic habitats (e.g., wetlands, floodplains, ephemeral pools, stream pools and riffles, man-made ponds) in close proximity to large tracts of intact forest (e.g., bottomland hardwood forest) (Duke 2009b; Dorcas 2009b). Amphibians represent tangible linkages among aquatic, wetland, and terrestrial habitats. The vast majority of amphibian species documented at London Creek require some type of aquatic habitat for reproduction, and as adults, they may occur at some distance or closely adjacent to breeding sites (SCDNR 2011b). For example, the presence of amphibians dependent on ephemeral pools and wetlands (i.e., marbled and spotted salamanders) at multiple sites indicates suitable breeding habitat for these species exists throughout the area (Duke 2009b; Dorcas 2009b).

The substantial diversity and abundance of turtles in the farm ponds within the London Creek watershed is typical of Piedmont habitats (Duke 2009b; Dorcas 2009b). However, these ponds are not indicative of the environmental integrity of the London Creek riparian habitat and adjacent wetland or terrestrial habitats (SCDNR 2011b).

Frogs and Toads. The observed frogs and toads of the Make-Up Pond C study area range from fully aquatic (e.g., bullfrog) to semi-aquatic (e.g., toad species, treefrogs) in their habits. In 2008 and 2009, 11 species of frogs and toads (i.e., northern cricket frog, Cope's gray treefrog, spring peeper, upland chorus frog, green frog, pickerel frog, Southern leopard frog, bullfrog, American toad, Fowler's toad, and eastern narrowmouth toad) were observed. These 11 species range from common (observed three to seven times) to abundant (observed eight or more times), except for the eastern narrowmouth toad, which was somewhat rare (observed two times) (Dorcas 2009b). All 11 species are closely tied to water (e.g., wetlands, temporary pools, and low-gradient streams and rivers), which is where they reproduce. Further, as juveniles and adults, all the frog and toad species, except the bullfrog, may make extensive use of adjacent terrestrial habitats (e.g., forest, grassland, and cropland).

Salamanders and Newts. Salamanders and newts range from fully aquatic (e.g., red-spotted newt) to semi-aquatic (e.g., all salamander species observed) in their habitats. A total of 8 of 11 potential salamander and newt species were observed in 2008 and 2009: spotted salamander, marbled salamander, northern dusky salamander, Atlantic Coast slimy salamander, northern red salamander, southern two-lined salamander, spring salamander [*Gyrinophilus porphyriticus*]), and red-spotted newt. All eight salamander/newt species were considered common to abundant, except for the spring salamander (somewhat rare) and red salamander (rare [one observation]) (Dorcas 2009b). The semi-aquatic salamanders and fully aquatic newt are closely tied to water, such as trickling streams and wetlands where they reproduce. Adult semi-aquatic salamanders also use adjacent terrestrial habitat such as forests and grasslands. The mud salamander (*Pseudotriton montanus*), four-toed salamander (*Hemidactylium scutatum*), and three-lined salamander (*Eurycea guttolineata*) were not observed in the Make-Up Pond C study area, likely due to their fossorial behavior (NatureServe Explorer 2012a, b, c). However, these species are likely present due to habitat integrity and the fact that the other 8 (more readily detected) of the 11 potentially occurring salamander species in the area were observed.

Turtles. The turtle species use aquatic habitats ranging from rivers and streams to still-water habitats such as wetlands. The lifestyles of these turtles range from mostly aquatic (e.g., common snapping turtle) to semi-aquatic (all the other turtle species). A total of four turtle species were observed in 2008 and 2009: eastern mud turtle, eastern river cooter, eastern box turtle, and snapping turtle. The four species ranged from common to rare (Dorcas 2009b). All the turtle species leave the water to nest and to bask. Nesting (egg deposition) is accomplished in soft substrates near water. Hibernation/burrowing during inactive periods may occur in soft soil or in fallen logs/debris, soft substrates underwater, or under rocks or in holes in banks, depending on the species and habitat availability.

Lizards. The lizard species range from mostly arboreal (e.g., green anole and broadhead skink [*Eumeces laticeps*]) to terrestrial (e.g., ground skink). A total of five lizard and skink species were observed in 2008 and 2009: fence lizard, six-lined racerunner, green anole, broadhead skink, and ground skink. These five species ranged from abundant to rare (Dorcas 2009b). All of these species inhabit upland habitats, but may be found in upland areas near wetland or other aquatic habitats, although they have no particular affinity for them, and all spend periods of inactivity underground or in crevices, and deposit eggs in soil, litter, or debris.

Snakes. The snake species range from mostly aquatic (e.g., northern watersnake), to having an affinity for terrestrial habitats near water (e.g., garter snake [*Thamnophis sirtalis*]), to having no apparent affinity for water or terrestrial habitats near water (all the other snake species subsequently listed). A total of nine snake species were observed in 2008 and 2009: copperhead, worm snake, ringneck snake, northern black racer, black rat snake, eastern kingsnake (*Lampropeltis getula*), brown snake [*Storeria dekayi*]), northern watersnake, and garter snake. The nine species ranged from common to rare (Dorcas 2009b). All the snake species spend periods of inactivity underground or in crevices or burrows, and deposit eggs in soil, litter, debris, or abandoned mammal burrows.

2.4.1.3 Terrestrial Resources – Transmission-Line Corridors

As described in Section 2.2.3.1, Duke proposes to construct new transmission lines in two corridors, Route K and Route O, to connect the existing 230-kV and 525-kV transmission lines with the proposed Lee Nuclear Station Units 1 and 2 switchyards. Both the existing and proposed transmission lines are shown in Figure 2-5. From the switchyards, the corridors for Routes K and O would each be 325 ft wide to the tie in with the existing Pacolet-Catawba line. South of the Pacolet-Catawba line, the corridors for Routes K and O would each be 200 ft wide to the point where they would tie in to the existing Oconee-Newport line (Figure 2-5).

Existing Cover Types

An inventory of land cover within the two proposed transmission-line corridors and in the whole siting study area (283.47 mi^2) was made through analysis and classification of aerial photography, satellite imagery, and limited field investigations (Duke 2007c). Land-cover types and acreages within the two proposed transmission-line corridors are provided in Table 2-3. The most prevalent habitat, and the one with the greatest overall value to wildlife, is forest. The various types of forest cover a total of approximately 690 of the 987 ac within the two transmission-line corridors (HDR/DTA 2009b).

The following descriptions of the natural vegetation communities that occur in the transmission-line siting study area largely follow that provided by Nelson (1986) for the State of South Carolina as referenced in HDR/DTA (2009b). Because the descriptions are drawn from a much broader geographic area, they do not correlate exactly with the forest and shrub/scrub cover types within the two transmission-line corridors, but are provided for contextual reference.

Vegetation communities in the transmission-line siting study area include bottomland hardwoods, oak-hickory forests, active and fallow pastures, small stream forests, planted pine plantations, and shallow freshwater swamps. Dominant vegetation in bottomland hardwood forests includes black willow, box elder, buttonbush, elderberry, sensitive fern, and spotted lady's thumb (*Polygonum persicaria*). Dominant vegetation typical of oak-hickory forest includes southern red oak (*Quercus falcata*), white oak, hickory, tulip poplar, flowering dogwood, basswood (*Tilia americana*), and poison ivy (*Toxicodendron radicans*). Dominant vegetation in active and fallow pastures includes redtop (*Agrostis alba*), various other grasses, and bull thistle (*Cirsium vulgare*). Planted pine areas consist of moderate to high-density stands of commercial species, such as loblolly pine, and recently cutover areas that now are in early successional growth. Dominant species in these areas include pioneer species such as sweet gum, black locust (*Robinia pseudoacacia*), tulip poplar, sourwood, sawtooth blackberry (*Rubus argutus*), asters, and American pokeweed (*Phytolacca americana*). Dominant vegetation within the small stream forests is similar to that of the bottomland hardwood forests, except that upland elements also are present in the small stream forests. Vegetation within shallow freshwater swamps is dominated by black willow and other obligate species; however, it may be distinguished from bottomland hardwood forest by the presence of standing water and the large number of standing snags (Nelson [1986] as referenced in HDR/DTA [2009b]).

Wetlands, Streams, and Floodplains

Wetlands were not identified in the inventory of land cover within the two proposed transmission-line corridors (see Table 2-3) at the scale at which the inventory was conducted. Thus, potentially jurisdictional wetlands and streams found within 25 ft of either side of the two transmission-line corridors (i.e., total of 250 ft wide for both corridors from the Oconee-Newport line to the Pacolet-Catawba line; total of 375 ft wide for both corridors from the Pacolet-Catawba line to the switchyard) were identified in the field (HDR/DTA 2009b). Wetlands include forested wetlands, scrub-shrub wetlands, and emergent wetlands. Wetlands are similar in composition to those on the Lee Nuclear Station site and within the Make-Up Pond C study area (Duke 2011h).

Jurisdictional Wetlands

Jurisdictional wetlands located within the jurisdictional determination boundary for the two new transmission lines total approximately 11.17 ac: 0.52 ac in the east corridor (Route O) and 10.65 ac in the west corridor (Route K) (USACE 2013a), or about 1 percent of the approximately

987 ac within the corridors for the two new transmission lines (Table 2-3). The four jurisdictional wetlands in the east corridor (Route O) range in size from 0.01 to 0.38 ac (USACE 2013a). The small wetlands are associated with small streams while the larger wetlands are located in active floodplains (HDR/DTA 2009b). The 12 jurisdictional wetlands in the west corridor (Route K) range in size from less than 0.01 ac to 7.66 ac (USACE 2013a), and include small fringe wetlands associated with small streams to large wetland/stream complexes (HDR/DTA 2009b).

Wetland Functional Assessment

Duke conducted functional assessments for jurisdictional wetlands within the two transmission-line corridors in the same manner as noted above for jurisdictional wetlands on the Lee Nuclear Station site (see Section 2.4.1.1). A total of 8 of the 12 wetland assessment areas in the Route K (western) corridor were classified as fully functional (functioning naturally as in an undisturbed condition), 3 assessment areas were classified as partially impaired (partial loss of functionality due to disturbance, but functional recovery is expected to occur through natural processes), and one assessment area was classified as impaired (partial loss of functionality due to disturbance which would require restoration activities to facilitate recovery) (Duke 2011h). Three of the four wetland assessment areas in the Route O (eastern) corridor were classified as being fully functional and the fourth was classified as partially impaired (Duke 2011h).

Streams

In their jurisdictional determination, the USACE identified a total of 70 stream crossings, extending 4.84 mi, in the Route O (eastern) corridor and 46 stream crossings extending 2.76 mi in the Route K (western) corridor (USACE 2013a). The streams range in size from small, first-order headwater channels to the Pacolet River (HDR/DTA 2009b). Streams are also discussed in Section 2.4.2.2.

Floodplains

Regulatory 100-year floodplains in the Route K (western) corridor occur in low-lying areas of Abingdon Creek, Gilkey Creek, Thicketty Creek, Mill Creek, Gault Creek, Fanning Creek, and the Pacolet River (Duke 2011h). Regulatory 100-year floodplains in the Route O (eastern) corridor occur in low-lying areas of the Quinton Branch, Abingdon Creek, Thicketty Creek, and the Pacolet River. Floodplains along the Pacolet River are wider than along these tributary streams (Duke 2011h).

Significant Natural Areas

During surveys for Federally and State-ranked plant species in selected areas of the transmission-line corridors in August and October 2009 and March and April 2010 (see

Section 2.4.1.6), a species-rich, mixed hardwood bluff was found on Abingdon Creek along the Route O corridor. It is dominated by beech and Florida maple, and supports a rich herbaceous layer of piedmontane and montane cove plant species, including the State-listed southern adder's-tongue fern (see Section 2.4.1.6 and Table 2-9) and nerveless sedge (*Carex leptonervia*) (Gaddy 2010).

Rare Plant Species

Nerveless sedge, a rare mesic-site species not reported in South Carolina by the South Carolina Plant Atlas (USC 2013) was found to be common in the noteworthy Abingdon Creek mixed hardwood bluff habitat (described above) (Gaddy 2010).

Wildlife

Wildlife within the two proposed transmission-line corridors has not been surveyed in the field. Further, outside of the jurisdictional wetlands and streams noted above, plant communities and habitat types have not been delineated in the field. The transmission-line corridors intersect more than 7 mi of jurisdictional streams, 11 ac of jurisdictional wetlands, and many floodplains. Bottomland hardwood forest in these areas likely supports a wide variety of wildlife due to relatively abundant habitat resources. For example, hardwood tree species (e.g., oaks [*Quercus* spp.] and hickories) provide mast, mature hardwood trees provide nest and den sites, and snags and downed woody debris provide sources of food and cover for mammals, birds, amphibians, and reptiles. Bottomland hardwood forests also provide travel corridors for mammals and migration, nesting, foraging, and winter habitat for birds (e.g., neotropical and nearctic migrants, and resident and migratory waterfowl). Riparian wildlife in the transmission-line corridors may be similar to that of the Make-Up Pond C study area, which also harbors substantial stream/wetland/floodplain complexes along London Creek and its tributaries.

In addition to intersecting many wetland areas and streams, the transmission-line corridors intersect upland plant community and habitat types, which are likely similar to those present in the Make-Up Pond C study area and on the Lee Nuclear Station site. The upland wildlife assemblages (which are similar to bottomland wildlife communities except for species closely tied to streams, wetlands, and floodplains) in the proposed transmission-line corridors are likely similar to those documented for the Lee Nuclear Station site and the Make-Up Pond C study area.

2.4.1.4 Terrestrial Resources – Railroad Corridor

As described in Section 2.2.3.2, Duke Power Company laid a 6.8-mi-long and 50-ft-wide (41.2 ac) railroad spur to support construction of the Cherokee Nuclear Station. The railroad spur was abandoned when construction of the Cherokee Nuclear Station was discontinued. Duke plans to upgrade the spur to support building the Lee Nuclear Station, altering the course slightly where the original ROW is occupied by the Reddy Ice facility. The detour involves approximately 1300 ft of track (Figure 2-6) in a 50-ft-wide corridor.

The western one-third of the realigned section is forested (0.5 ac), and the eastern two-thirds is in paved or maintained yard areas for the ice plant (Duke 2009c). The area of potential impact for the renovated (non-realigned) portion of the railroad spur is primarily the existing railroad bed and the parallel margins along each side that were disturbed during the earlier railroad construction for the unfinished Cherokee Nuclear Station (Duke 2009c).

The study area for the railroad-spur corridor extended 25 ft on both sides of the bottom of the 50-ft-wide berm of the rail embankment, creating a 100-ft-wide study area along the corridor (Enercon 2008). The information presented below on the various biota of the railroad-spur corridor is summarized from the results of surveys conducted within this study area.

Existing Cover Types

Vegetation along the existing railroad-spur corridor was not inventoried in support of the ER for the unfinished Cherokee Nuclear Station (Duke Power Company 1974a, b, c). However, upland vegetation and streams and wetlands and associated vegetation along the existing railroad-spur corridor were inventoried in support of the COL application for Lee Nuclear Station Units 1 and 2 (Enercon 2008). Excerpted information from this report is provided in this subsection.

Vegetation communities along the railroad-spur corridor include grass-forb (railroad line surface and road crossings), early successional forests (young pine and mixed hardwoods less than 30 ft tall), pine forests (planted and natural pines on ridges and upper slopes), pine-mixed hardwood forests (mesic upper slopes and previously disturbed lower slopes), and mixed hardwood forests (lower slopes, north-facing slopes, along streams and deep ravines) (Enercon 2008).

Wetlands, Streams, and Floodplains

<u>Jurisdictional Wetlands</u>

A total of three jurisdictional wetlands, comprising 0.066 ac were identified in the railroad corridor. The individual wetlands within the railroad corridor vary in size from 0.006 to 0.04 ac (USACE 2013a). Wetlands are similar in composition to those within the Make-Up Pond C study area.

<u>Wetland Functional Assessment</u>

Duke conducted field-based functional assessments for jurisdictional wetland areas within the railroad-spur corridor in the same manner as noted above for jurisdictional wetland areas on the Lee Nuclear Station site (see Section 2.4.1.1). All four of the wetland assessment areas in the railroad-spur corridor were classified as being fully functional (functioning naturally as in an undisturbed condition) (Duke 2011h).

Streams

All waterbodies associated with the existing railroad spur were previously channelized with culverts (Duke 2009c). The USACE identified a total of 21 stream crossings extending 1.13 mi within the railroad corridor (USACE 2013a). Riparian habitat associated with the streams includes typical bottomland species (Enercon 2008) described in Sections 2.4.1.1 through 2.4.1.3.

Floodplains

Regulatory 100-year floodplains in the railroad corridor occur in low-lying areas of Peoples Creek, Furnace Creek, London Creek, and Little London Creek (Duke 2011h).

Wildlife

Wildlife along the existing railroad-spur corridor was not inventoried in support of the ER for the unfinished Cherokee Nuclear Station (Duke Power Company 1974a, b, c). However, the avian and herpetofauna communities along the existing railroad-spur corridor were inventoried in support of the COL application for Lee Nuclear Station Units 1 and 2. Excerpted information from the respective reports on these two taxa is provided below.

Birds

The majority (4.9 mi) of the 6.8-mi-long railroad-spur corridor was intensively surveyed from April 7 through July 1, 2009 for migratory and breeding birds and raptor nests. Surveyed portions included the following vegetation types: bottomland hardwood forest, mesic mixed pine-hardwood forest, planted pine plantation (15 to 20 years old), cove forest (diverse hardwood species with a very dense canopy cover), cutover/open land, mesic mixed pine-hardwood forest with intersecting utility ROWs and residential properties, and various combinations of these vegetation types (HDR/DTA 2009c). Survey locations are noted in HDR/DTA (2009c). However, the 1300-ft portion of the railroad to be realigned (west of the Reddy Ice Plant (Figure 2-6) was not surveyed (HDR/DTA 2009c) because one part is highly disturbed and provides little vegetative habitat; another part would require cutting very few trees for railroad refurbishment; and another part lies in an existing Duke transmission-line corridor where trees and shrubs are cut or sprayed every 5 years (Duke 2010c).

Based on field guides, breeding bird surveys in the vicinity (i.e., London Creek in support of Make-Up Pond C and the North American Breeding Bird Survey [Chesnee, SC route], regional and State bird lists, and the South Carolina Breeding Bird Atlas, there are 108 breeding bird species that could potentially occur in the vicinity of the Lee Nuclear Station site. A total of 80 avian species were observed during the 2009 surveys, 50 of which were assumed to be breeding in the vicinity of the railroad-spur corridor. A total of 42 of the species were perching birds, 3 were birds of prey (i.e., barred owl [*Strix varia*], red-shouldered hawk, red-tailed hawk), 2 were woodpeckers (i.e., downy woodpecker and red-bellied woodpecker), 3 were upland game birds (i.e., mourning dove and wild turkey), and 1 was the chimney swift (*Chaetura pelagica*). The only raptor species that appeared to actually be nesting in the area of the railroad-spur corridor was the barred owl; however, no raptor nests were observed along the margin of the railroad-spur corridor (HDR/DTA 2009c).

The most species-rich habitat along the railroad-spur corridor was the planted pine plantation, which accounts for about 27 percent of the surveyed portion of the railroad-spur corridor. The high species diversity in this cover type is presumably due to the presence of young hardwoods that stems from the lack of canopy closure of the young pines. Avian species diversity in this habitat type is projected to decrease as the young pines age and canopy closure occurs, thus reducing the prevalence of the shade-intolerant hardwoods (HDR/DTA 2009c). The noteworthy lack of waterfowl, shorebirds, and colonial-nesting waterbirds is due to the lack of open water and wetland habitats along the railroad-spur corridor (Enercon 2008; HDR/DTA 2009c).

Amphibians and Reptiles

The majority of the 6.8-mi-long railroad-spur corridor was surveyed from February through July 2009 for amphibians and reptiles in aquatic and terrestrial habitats (Dorcas 2009c). Survey locations are noted in Dorcas (2009c). One location, where London Creek intersects the railroad-spur corridor, was sampled in 2008 as part of the amphibian and reptile investigation of the Make-Up Pond C study area (Dorcas 2009b) and was not sampled again during 2009 (Dorcas 2009c). In addition, the forested one-third of the 1300-ft portion of the railroad-spur corridor to be realigned (west of the Reddy Ice Plant) (Figure 2-6) was not surveyed (Dorcas 2009c). Surveyed habitats adjacent to and within the railroad-spur corridor included ponds, seeps, puddles, and forest (Dorcas 2009c).

According to geographic distribution maps, species records for Cherokee County obtained from 47 museums and universities, and available suitable habitat, 25 amphibian and 41 reptile species potentially occur along the railroad-spur corridor. A total of 33 species of amphibians and reptiles were observed during the 2009 and 2008 surveys, 11 frog and toad species, 6 salamander species, 5 turtle species, 3 lizard species, and 8 snake species. This high diversity is in part likely due to the large number of habitat types through which the railroad-spur corridor passes and the high species diversity in that portion of Cherokee County (Dorcas 2009c).

Commonly found abundant amphibians included the pickerel frog, cricket frog, Fowler's toad, bullfrog, green frog, spring peeper, southern leopard frog, and northern dusky salamander. Commonly found abundant reptiles included the eastern box turtle, green anole, six-lined racerunner, worm snake, black racer, and rat snake. The herpetofauna of the railroad-spur corridor is similar to the herpetofauna found throughout the Piedmont of the Carolinas (Dorcas 2009c).

Important habitats include the wetlands where London Creek crosses the railroad-spur corridor and the large puddles within the corridor, which support a number of amphibians including pickerel frogs and cricket frogs. These habitats were also frequented by box turtles. The railroad-spur corridor itself provides ideal habitat for box turtles (Dorcas 2009c).

2.4.1.5 Offsite Road Improvements

Improvements to existing offsite roads will occur at nine locations in six areas covering about 85 ac along SC 18 and SC 329 and McKowns Mountain Road. No jurisdictional wetlands or streams occur at these locations. However, a regulatory 100-year floodplain associated with the Broad River occurs in a road-improvement area along SC 329 (Duke 2011h).

2.4.1.6 Important Terrestrial Species and Habitats

The NRC has defined important species as any that are rare, ecologically sensitive, play an ecological role, or are relied on by a valuable species, and/or have economic or recreational value (NUREG-1555 [NRC 2000a]). The FWS identifies Federally threatened or endangered species in 50 CFR 17.11 and 50 CFR 17.12. Important species include those that are proposed or candidates for listing as Federally threatened or endangered. Important species also include species ranked as critically imperiled (S1), imperiled (S2), or vulnerable (S3) by the State of South Carolina, some of which may also be designated as threatened or endangered by the State. Biological indicator species that respond to and indicate environmental change are also classed as important species.

In a letter dated April 9, 2008, the NRC requested that the FWS Field Office in Atlanta, Georgia, provide information regarding Federally listed, proposed, and candidate species and critical habitat that may occur in the vicinity of the Lee Nuclear Station (NRC 2008e). On May 13, 2008, the FWS provided a response letter indicating three listed and one candidate species and no critical habitat in Cherokee, Union, and York Counties (FWS 2008a), which encompass the Lee Nuclear Station site, the Make-Up Pond C site, the two proposed transmission-line corridors, the railroad-spur corridor, and the six offsite road-improvement areas. These species include the pool sprite (*Amphianthus pusillus*), Georgia aster (*Symphyotrichum georgianum* [formerly *Aster georgianus*]), dwarf-flowered heartleaf (*Hexastylis naniflora*), and Schweinitz's sunflower (*Helianthus schweinitzii*). An additional listed species identified that may occur in the project area is the smooth coneflower (*Echinacea laevigata*) (Cantrell 2008). Life-history attributes and habitat affinities of these species that are relevant to the review of Duke's application are summarized in this section. In addition, the potential occurrence of these species on, and in the vicinity of, the project area is summarized in this section.

Important Terrestrial Species

Federally listed, proposed, or candidate species and State-ranked species were surveyed for studies commissioned by Duke for the major components of the Lee Nuclear Station Units 1 and 2 COL and formerly for the Cherokee Nuclear Station ER, including mammals (Duke Power

Company 1974a, b, c), birds (HDR/DTA 2009a), amphibians and reptiles (Dorcas 2007, 2009a), Federally and State-listed plant species (Gaddy 2009); Make-Up Pond C (mammals [Webster 2009], birds [DTA 2008b], amphibians and reptiles [Dorcas 2009b], Federally listed and State-ranked plant species and significant natural areas [Gaddy 2010]); the two proposed transmission-line corridors (habitat for Federally listed and State-ranked wildlife and plant species [HDR/DTA 2009b], Federally listed and State-ranked plant species [Gaddy 2010]); and the railroad-spur corridor (birds [HDR/DTA 2009c], amphibians and reptiles [Dorcas 2009c], habitat for Federally and State-listed wildlife and plant species [Enercon 2008], and Federally and State-listed plant species (Duke 2009e, 2010c).

The specific locations of all survey routes, transects, sampling points, etc., are provided in the individual study reports referenced above. Federally listed and State-ranked species that potentially could occur and those observed on and in the vicinity of the Lee Nuclear Station site, the Make-Up Pond C site, the two proposed transmission-line corridors, and the railroad-spur corridor are listed in Table 2-9. The general level of effort, temporal coverage, and results of these surveys with regard to general biota are discussed above in Sections 2.4.1.1 through 2.4.1.4. The results of these surveys with regard to Federally listed and State-ranked species are discussed below.

<u>Lee Nuclear Station Site</u>

During field reconnaissance on the Lee Nuclear Station site in 2006, the interiors of several abandoned buildings onsite were examined for bats and guano before their removal. However, no bats or guano were found (Duke 2009c, 2008e). Given the isolated occurrences of southeastern myotis (*Myotis austroriparius*) (Table 2-9) in the Piedmont (see below), it is unlikely that the species would have maternity roosts or winter hibernacula on the Lee Nuclear Station site.

During the avian migration and breeding surveys on the Lee Nuclear Station site in 2009, suitable habitat for Federally listed and State-ranked species (Table 2-9), such as the bald eagle and loggerhead shrike (*Lanius ludovicianus*), was searched visually and via responses to call back recordings. No Federally listed or State-ranked avian species were recorded. However, the loggerhead shrike (Table 2-9) was observed on the Cherokee Nuclear Station site during the fall, winter, spring, and summer avian survey periods in 1973 and 1974 (Duke Power Company 1974a, b, c; Duke 2009c). The site offers much more suitable habitat now than it did during the 1970s (i.e., large expanses of open/field/meadow and upland scrub habitats created by construction of the Cherokee Nuclear Station). The shrike may be sufficiently rare that it was not observed during the 2009 surveys (HDR/DTA 2009a) but likely occurs year-round at the Lee Nuclear Station site, as it was observed during the breeding season outside of the Make-Up Pond C study area.

Table 2-9. Important Species that Potentially Occur in the Project Area for the Proposed Lee Nuclear Station Units 1 and 2, Including an Indication of Their Presence within the Project Footprint Based on Field Surveys

Scientific Name	Common Name	Federal/ State Status[a]	Nearest County(ies) of Known Occurrence	Lee Nuclear Station[b]	Make-Up Pond C[b]	Railroad Corridor[b]	Transmission-Line Corridors[b]
Mammals							
Myotis austroriparius	southeastern myotis bat[c]	S1	Cherokee[d,e,f,g]				
Myotis lucifugus	little brown bat	S3?	Greenville[f,h]				
Neotoma floridana	eastern woodrat	S3S4	Greenville[g,h]/York[k]				
Peromyscus polionotus	oldfield mouse	S1 (North Carolina)[i]	Cleveland[i]/Rutherford[i]				
Birds							
Haliaeetus leucocephalus	bald eagle	BGEPA/S2 (SE)	Chester[g,j]/York[g,k]				
Lanius ludovicianus	loggerhead shrike	S3	Florence[l]		X[m]		
Reptiles							
Lampropeltis triangulum	scarlet kingsnake (milksnake)	S2	Statewide[n]				
Pituophis melanoleucus	pine snake	S3S4	Statewide[n]				
Sistrurus miliarius	pigmy rattlesnake	S3 (North Carolina)[i]	Statewide except Blue Ridge Mountains[n]				
Plants							
Agalinis auriculata	ear-leaved foxglove	S1	York[k]				
Agrimonia pubescens	soft grooveburr[c]	S1	York[k]				
Allium cernuum	nodding onion[c]	S2	Cherokee[d]				
Amorpha schwerinii	Schwerin's indigobush	S1	Union[o]				
Amphianthus pusillus	pool sprite	FT/S1	York[g,k,p]				
Asplenium bradleyi	Bradley's spleenwort[c]	S1	York[k]				

Table 2-9. (contd)

Scientific Name	Common Name	Federal/ State Status[(a)]	Nearest County(ies) of Known Occurrence	Lee Nuclear Station[(b)]	Make-Up Pond C[(b)]	Railroad Corridor[(b)]	Transmission-Line Corridors[(b)]
Carex gracillima	graceful sedge	S2	Union[(o)]				
Carex prasina	drooping sedge	S2	Union[(o)]		X		
Carex scabrata	rough sedge[(c)]	S2	Cherokee[(d)]				
Circaea lutetiana ssp. *canadensis*	southern enchanter's nightshade	S3	Spartanburg[(q)]		X		
Cyperus granitophilus	granite-loving flatsedge	S1?	York[(k)]				
Dasistoma macrophylla	mullein foxglove	S1	York[(k)]				
Echinacea laevigata	smooth coneflower	FE/S3	Pickens[(p,r)]/Lancaster[(p,s)]				
Eleocharis palustris	spike-rush[(c)]	S1?	York[(k)]				
Hackelia virginiana	Virginia stickseed	S1	Union[(o)]				
Helianthus laevigatus	smooth sunflower[(c)]	S2	Cherokee[(d)]/Union[(o)]/York[(k)]				
Helianthus schweinitzii	Schweinitz's sunflower	FE/S3	York[(g,k,p)]				
Hexastylis naniflora	dwarf-flowered heartleaf[(c)]	FT/S3	Cherokee[(d,g,p)]/York[(g,p)]				
Hydrangea cinerea	ashy hydrangea[(c)]	S1	Cherokee[(d)]				
Hymenocallis coronaria	shoals spider-lily	S2	Chester[(j)]/Union[(o)]/York[(k)]				
Isoetes piedmontana	Piedmont quillwort[(c)]	S2	York[(k)]				
Juglans cinerea	butternut (white walnut)	S3	York[(k)]				
Juncus georgianus	Georgia rush	S2	York[(k)]				
Lilium canadense	Canada lily	S1	York[(k)]				
Lipocarpha micrantha	dwarf bulrush	S2	York[(k)]				
Melanthium virginicum	Virginia bunchflower	S2	York[(k)]				
Menispermum canadense	Canada moonseed[(c)]	S2S3	Cherokee[(d)]/Chester[(j)]/York[(k)]		X		

Table 2-9. (contd)

Scientific Name	Common Name	Federal/ State Status[a]	Nearest County(ies) of Known Occurrence	Lee Nuclear Station[b]	Make-Up Pond C[b]	Railroad Corridor[b]	Transmission-Line Corridors[b]
Minuartia uniflora	one-flowered stitchwort[c]	S3	Union[o]/York[k]				
Monotropsis odorata	sweet pinesap	S2	Union[o]				
Najas flexilis	slender naiad[c]	S1	York[k]				
Ophioglossum vulgatum	southern adder's-tongue fern[c]	S2	Cherokee[d]/Chester[j]/Union[o]	X	X		X
Orobanche uniflora	single-flowered cancer root	S2	Charleston[t]		X		
Poa alsodes	blue grass[c]	S1?	York[k]				
Quercus bicolor	swamp white oak	S1	York[k]				
Quercus oglethorpensis	Oglethorpe's oak	S3	York[k]				
Ranunculus fascicularis	early buttercup	S1	Chester[j]/York[k]				
Ratibida pinnata	gray-headed prairie coneflower	S1	Chester[j]/York[k]				
Rhododendron eastmanii	Creel's azalea (May white)	S2	Union[o]/York[k]				
Rudbeckia heliopsidis	sun-facing coneflower[c]	S1S2	York[k]				
Scutellaria parvula	dwarf skullcap	S2S3	Chester[j]/York[k]				
Sedum pusillum	granite rock stonecrop	S2	Union[o]				
Silphium terebinthinaceum	prairie rosinweed	S1	Union[o]/York[k]				
Solidago rigida	rigid prairie goldenrod	S1	Union[o]/York[k]				
Symphyotrichum georgianum	Georgia aster[c]	FC/SNR	Cherokee[d,g,p]/York[g,k,p]/ Union[g,o,p]		X		
Thermopsis mollis	soft-haired thermopsis[c]	S1	York[k]				
Tiarella cordifolia var. cordifolia	heart-leaved foamflower	S2	York[k]				
Torreyochloa pallida	pale manna grass[c]	S1	York[k]				
Trillium rugelii	southern nodding trillium	S2	York[k]				

Table 2-9. (contd)

Scientific Name	Common Name	Federal/ State Status[a]	Nearest County(ies) of Known Occurrence	Lee Nuclear Station[b]	Make-Up Pond C[b]	Railroad Corridor[b]	Transmission-Line Corridors[b]
Verbena simplex	narrow-leaved vervain	S1	Union[o]/York[k]				
Veronicastrum virginicum	Culver's root	S1	York[k]				
Xerophyllum asphodeloides	turkey-beard[c]	S2	Cherokee[d]				

(a) Federal status (FE = Federal endangered; FT = Federal threatened; FC = Federal candidate, BGEPA= Federally protected under the Bald and Golden Eagle Protection Act) taken from the FWS (2008a,c) unless otherwise indicated. State status (S1 = critically imperiled; S2 = imperiled; S3 = vulnerable; S4= apparently secure; ? or two ranks listed together for the same species= inexact numeric rank; SE = endangered; SNR = unranked (conservation status not yet assessed) taken from the SCDNR (2012a) unless otherwise indicated.
(b) Based on direct observation within the project footprint unless otherwise noted.
(c) These species also occur within a 15-mi radius of the Lee Nuclear Station site (SCDNR 2012b).
(d) SCDNR (2012c)
(e) Webster (2009)
(f) Menzel et al. (2003)
(g) FWS (2008a,c)
(h) SCDNR (2012d)
(i) NCNHP (2013)
(j) SCDNR (2012e)
(k) SCDNR (2012f)
(l) SCDNR (2012g)
(m) Based on observations made along roadways near Make-Up Pond C
(n) Savannah River Ecology Laboratory Herpetology Program (2011)
(o) SCDNR (2012h)
(p) FWS (2012a)
(q) SCDNR (2012i)
(r) SCDNR (2012j)
(s) SCDNR (2012k)
(t) SCDNR (2012l)

The reptile surveys on the Lee Nuclear Station site in 2007, 2008, and 2009, targeted the three State-ranked snake species listed in Table 2-9); however, none were observed (Dorcas 2007, 2009a).

In March and April 2008, suitable habitat on the Lee Nuclear Station site was searched for the dwarf-flowered heartleaf. The dwarf-flowered heartleaf was not observed (Duke 2008e). In October 2008, much of the open/field/meadow cover type on the Lee Nuclear Station site (the unfinished Cherokee Nuclear Station site) (see Section 2.4.1.1), including that which overlays Iredell and Mecklenberg soils, was searched for four Federally listed and State-ranked plant species (Table 2-9) known to occupy primarily open, non-forested habitats. None of the four species (smooth coneflower, Schweinitz's sunflower, Georgia aster, and smooth sunflower [*Helianthus laevigatus*]) were found (Duke 2010c).

A population of southern adder's-tongue fern was observed during pedestrian field reconnaissance of the Lee Nuclear Station site in 2006. The population consisted of 25 individuals located in a ravine above an old, man-made stock pond in cutover beech/mixed hardwood forest in the southwestern portion of the site. This observation represents a range expansion for the species, as it was not previously recorded in Cherokee or York Counties (Duke 2008e, 2009c).

<u>Make-Up Pond C Site</u>

In the Make-Up Pond C study area in 2008 and 2009, four Federally listed and State-ranked mammal species (Table 2-9) were surveyed during small mammal trapping and pedestrian searches. None of these species was observed (Webster 2009).

During the avian migration and breeding surveys in the Make-Up Pond C study area in 2008, no particular methods were employed to survey Federally listed and State-ranked species (as was done at the Lee Nuclear Station site and along the railroad-spur corridor). Federally listed and State-ranked species surveyed at the Lee Nuclear Station site and along the railroad-spur corridor were not recorded in the Make-Up Pond C study area (DTA 2008b). However, miscellaneous sightings of the loggerhead shrike were made along roadways near Make-Up Pond C (Duke 2010d).

During the reptile surveys in the Make-Up Pond C study area in 2008 and 2009, searches for the three State-ranked snake species noted above for the adjacent Lee Nuclear Station site were conducted. These three species were not observed (Table 2-9) (Dorcas 2009b).

During vegetation surveys in the Make-Up Pond C study area in 2008 and 2009, one Federally listed candidate species and five State-ranked plant species (Table 2-9) were found. Five Georgia aster plants with 10 flowering stems were found in 2008 in a transmission-line corridor. In an October 2009 revisit to the site, 14 flowering stems were present. About 20 drooping sedge plants were found along a tributary of London Creek. Approximately 25 southern enchanter's nightshade plants were found in lowland mixed hardwood forest. Two stems of single-flowered cancer root were found along London Creek in lowland hardwood forest. Six stems of Canada moonseed (*Menispermum canadense*) were found growing in an opening along a tributary of London Creek (Duke 2011h, Gaddy 2009). The drooping sedge, southern enchanter's nightshade, single-flowered cancer root, and Canada moonseed occurrences were each in a single location, each in association with southern adder's-tongue fern (Duke 2011h). Hundreds of southern adder's-tongue fern plants, many of them fertile, were found in 2008 at two locations in lowland hardwood forest. In 2009, numerous subpopulations of the fern also were found in the floodplain of London Creek (Gaddy 2009).

<u>Transmission-Line Corridors</u>

Suitable habitat for Federally listed and State-ranked birds and amphibian species, as well as the presence of the species, was noted during general wetland and stream surveys of the two proposed transmission-line corridors conducted in April and May of 2009 (HDR/DTA 2009b; Duke 2010d).

No caves or cave-like environments (e.g., mine shafts), which may serve as potential hibernacula/maternity roosts for southeastern myotis bats, were observed in the two transmission-line corridors. However, several abandoned buildings, which may serve as potential maternity roosts, were observed within the corridors but not investigated (Duke 2010d).

No bald eagles were observed during visual surveys for eagles and their habitat. The only potential habitat for the bald eagle was observed along the Broad River, but no potential nest trees (i.e., trees with large canopies with sufficiently large branches to support a nest) close to the Broad River were observed. Suitable habitat for the loggerhead shrike (i.e., clearings, pastureland and scrubby areas) exists in the transmission-line corridors. Although the shrike was not observed, the miscellaneous sightings along roadways near the proposed Make-Up Pond C site, as mentioned earlier in this section, indicate that it likely uses suitable corridor habitat (Duke 2010d).

Surveys for Federally listed and State-ranked plant species were conducted in ten selected areas of the transmission-line corridors in August and October 2009 and March and April 2010. The survey areas were selected based on comparison of false color infrared imagery of the habitats within the proposed transmission-line corridors and the habitat affinities of the Federally listed and State-ranked plant species. No Federally listed plant species were found, and only one State-ranked plant species was observed, southern adder's-tongue fern. The fern was found at three locations, two along the east transmission-line corridor (Route O) and one along the west transmission-line corridor (Route K) (Duke 2011h; Gaddy 2010).

Railroad Corridor

During the avian migration and breeding surveys in the railroad-spur corridor in 2009, the same survey methods employed at the Lee Nuclear Station site for the same Federally listed and State-ranked species (see related subsection above) were used along the railroad-spur corridor. None of the Federally listed and State-ranked species surveyed were recorded along the railroad-spur corridor (HDR/DTA 2009c).

During the reptile surveys along the railroad-spur corridor in 2009, searches were made for the three State-ranked snake species noted above for the adjacent Lee Nuclear Station site. None of the species were observed (Dorcas 2009c).

In October 2008, most of the railroad-spur corridor (i.e., the non-realignment portion) was searched for four Federally listed and State-ranked plant species (Table 2-9) known to occupy primarily non-forested habitats (i.e., smooth coneflower, Schweinitz's sunflower, Georgia aster, and smooth sunflower). The railroad-spur corridor was mostly searched on foot and none of the four species were found. However, three populations of Georgia aster were found nearby, one within 500 ft of the railroad-spur corridor, on roadsides, and transmission-line corridors. Also, one population of smooth sunflower was found within 0.5 mi of the railroad-spur corridor on a transmission-line corridor that crosses the railroad line (Duke 2010c). In September 2008, a separate botanical survey was conducted of the 1300-ft realignment portion of the railroad-spur corridor. Suitable habitat for three State-ranked species (nodding onion [*Allium cernuum*], Canada moonseed, and southern adder's-tongue fern) was present, but none of these species were observed (Duke 2009e).

Offsite Road Improvements

No Federally listed, proposed, or candidate species or State-ranked species have been documented by the FWS or the SCDNR as occurring within the six offsite road-improvement areas (Duke 2011h).

Federally Listed Species

The Federally listed, proposed, or candidate species known to occur (detected in surveys of the Lee Nuclear Station Units 1 and 2 COL project area [Table 2-9]) or that potentially could occur in the project area (although not detected in species-specific surveys) are described below. The NRC staff's correspondence to the FWS regarding these species is listed in Appendix F. Information about the occurrence of these species in the project area, as well as life-history attributes of these species that are pertinent to the review of Duke's application, are summarized in this subsection.

<u>Dwarf-flowered Heartleaf (*Hexastylis naniflora*)—Federally Threatened and State Vulnerable (S3)</u>. Dwarf-flowered heartleaf is an evergreen herb. Soil type is the most important habitat requirement of the species (54 FR 14964). It needs acidic Pacolet, Madison gravelly sand loam, or Musella fine sandy loam to grow (Duke 2009c). Given these soil types, the plant occupies bluffs and nearby slopes, boggy areas adjacent to the headwaters of creeks and streams, and hillsides and ravines (NatureServe Explorer 2010). The dwarf-flowered heartleaf is found only in the upper Piedmont regions of North and South Carolina, where approximately 108 populations occur in a 12-county area, with one relatively large population (Cowpens National Battlefield) that numbers over 10,000 plants and several smaller populations located in Cherokee County (FWS 2011b).

<u>Georgia Aster (*Symphyotrichum georgianum* [formerly *Aster georgianus*])—Federal Candidate and State Unranked – Conservation Status Not Yet Assessed (SNR)</u>. Georgia aster is a perennial, colonial herb that is a relict species of the post oak (*Quercus stellata*) savannah-prairie communities that existed in the Carolina Piedmont prior to widespread fire suppression and extirpation of large grazing animals. It now occupies a variety of dry habitats in areas adjacent to roads; along woodland borders; in dry, rocky woods; and within utility ROWs on low acidic or highly alkaline soil where current land management mimics natural disturbance. The primary controlling factor in its location is the availability of light, as it tends to decline when shaded by woody species. It reproduces mostly vegetatively (Duke 2009c; FWS 2010a).

<u>Pool Sprite (*Amphianthus pusillus*)—Federally Threatened and State Critically Imperiled (S1)</u>. Pool sprite is endemic to granite outcrops in the Piedmont physiographic region of the southeastern United States. The species is known from Alabama, Georgia, and South Carolina, including an estimated four sites in York County, South Carolina (FWS 2008b). Optimal habitat for the species has been consistently described as pools surrounded by a rock rim several centimeters in height and sandy-silty soils with low organic matter content (53 FR 3560; FWS 2008b).

<u>Schweinitz's Sunflower (*Helianthus schweinitzii*)—Federally Endangered and State Vulnerable (S3)</u>. Schweinitz's sunflower is a rhizomatous perennial herb that is found in clayey soils on the edges of woodlands and on roadsides, formerly in areas with post oak-blackjack oak (*Quercus marilandica*) savannahs, xeric oak-pine woodlands, or "Piedmont prairies," now primarily on mowed road or transmission-line corridors, with the populations nearest to the Lee Nuclear Station site located in eastern York County (56 FR 21087; FWS 2010b).

<u>Smooth Coneflower (*Echinacea laevigata*)—Federally Endangered and State Vulnerable (S3)</u>. Smooth coneflower is a rhizomatous perennial herb that grows in open woods, cedar barrens, roadsides, clearcuts, dry limestone bluffs, and transmission-line corridors, usually on magnesium- and calcium-rich soils associated with diabase and marble soils in South Carolina (57 FR 46340). Although not known to occur in Cherokee or York Counties (FWS 2011d), suitable habitat is present in the vicinity of the Lee Nuclear Station site.

State-Ranked Species

State-ranked species detected in surveys of the project area (Table 2-9) or likely to occur within the project footprint, regardless of not being detected during surveys, are described below. Although it was not detected in surveys, the bald eagle is discussed because of its recent former listing as a Federally threatened species.

Bald eagle (*Haliaeetus leucocephalus*)—State Imperiled (S2) and Endangered (SE). The bald eagle is a bird of aquatic ecosystems, frequenting major rivers, large lakes, reservoirs, estuaries, and some seacoast habitats. Fish are the major component of its diet, but waterfowl, seagulls, and carrion are eaten also. Bald eagles usually nest in large trees along shorelines in relatively remote areas that are free of disturbance (64 FR 36454).

The bald eagle was listed as Federally threatened but is now considered by the FWS to be recovered in the conterminous United States and was thus removed from the Federal list of endangered and threatened wildlife in 2007 (72 FR 37346). However, the bald eagle is listed as a threatened species (SC Code Ann. Regs. 123-150), receives protection as a non-game species (SC Code Ann. 50-15-10) in South Carolina, and is still afforded Federal protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) and the Migratory Bird Treaty Act (16 U.S.C. 703-712). The bald eagle is not known from Cherokee County, but is known to reside in York County located just to the east across the Broad River (FWS 2008a).

Canada Moonseed (*Menispermum canadense*)—State Imperiled (S2). Canada moonseed is a perennial woody vine that is typically found in moist, nutrient-rich forests, and along streams and bluffs (HDR/DTA 2009b). It is considered imperiled in South Carolina (NatureServe Explorer 2010).

Drooping Sedge (*Carex prasina*)—State Imperiled (S2). Drooping sedge occurs on wooded seepage slopes and stream banks, lowland woods, glades, and spring heads (HDR/DTA 2009b; NatureServe Explorer 2010). It is considered imperiled in South Carolina (NatureServe Explorer 2010).

Eastern Woodrat (*Neotoma floridana*)—State Vulnerable (S3). Woodrat habitat in the southern United States includes wooded areas, ravines, floodplain forest, and swamps, where the species builds large stick nests (NatureServe Explorer 2010). In North and South Carolina, the species occurs along the Blue Ridge Mountains (Webster 2009), which are located in the extreme northwestern corner of South Carolina. It is considered vulnerable in South Carolina (NatureServe Explorer 2010).

Loggerhead Shrike (*Lanius ludovicianus*)—State Vulnerable (S3). The loggerhead shrike is a year-round resident in the southeastern United States (Kaufman 2000). Suitable habitat for the shrike consists of grassland or other open habitat with scattered trees and thorny shrubs for foraging, nesting, and perching. The species feeds on small prey such as insects, arthropods, small mammals, birds, reptiles, amphibians, and occasionally carrion (Dechant et al. 1998). The shrike is one of South Carolina's highest priority bird species for conservation (SCDNR 2005).

The SCDNR Breeding Bird Atlas Project indicates the shrike is a probable breeder in Cherokee County (SCDNR 2010a). The species was recorded as recently as 1994 along the North American Breeding Bird Survey Chesnee, SC route located about 20 mi northwest of the Lee Nuclear Station, but was not recorded from 1995 through 2003 (Sauer et al. 2007).

<u>Single-flowered Cancer Root (*Orobanche uniflora*)—State Imperiled (S2)</u>. Cancer root is a perennial, parasitic herb that occurs in lowland woods (Gaddy 2009). It is considered imperiled in South Carolina (NatureServe Explorer 2010).

<u>Southeastern Myotis (*Myotis austroriparius*)—State Critically Imperiled (S1)</u>. The southeastern myotis is restricted to riverine habitats in the southeastern United States. The species is generally restricted to the coastal plain of North and South Carolina (Webster 2009), with isolated occurrences in the Piedmont of South Carolina (Menzel et al. 2003). For example, a single specimen was taken from an abandoned gold mine near Smyrna in Cherokee County (Menzel et al. 2003), and there is an unpublished record from Cherokee County in the Kings Mountain National Military Park database (Webster 2009).

In the Coastal Plain, the species may use basal cavities (for maternity roosts) and chimney cavities (winter hibernacula) that develop in mature hardwood trees of large stature due to heart rot. Cavities used by these species are best known from cypress (*Taxodium distichum*) and tupelo gum (*Nyssa* spp.) in bottomland hardwood swamps (WES 2008). There are no cypress-gum swamps in the project footprint. Cavities in other hardwood species, such as white oak and sugarberry, are also known to be used by the species (WES 2008). Although these trees are prevalent in the project footprint, there are apparently few large enough to develop cavities. The species also may establish maternity roosts in abandoned buildings near permanent sources of water (Kentucky Bat Working Group 2011; Webster 2009), but there are no abandoned buildings in the project footprint, except for those in the two proposed transmission-line corridors noted above. The species typically hibernate in caves (Kentucky Bat Working Group 2011), but there are no caves or cave-like structures on the Lee Nuclear Station site. Thus, although the southeastern myotis might forage over the slow-moving reaches of the Broad River in southern Cherokee County, it is very unlikely that it occurs in the unfavorable roosting and foraging habitats that characterize the London Creek area (Webster 2009).

<u>Southern Adder's-tongue Fern (*Ophioglossum vulgatum*)—State Imperiled (S2)</u>. This small fern, often less than 2 in. tall, is found in shady, circumneutral ravines and creek floodplains in the Piedmont of South Carolina (Duke 2009c). It is considered imperiled in South Carolina (NatureServe Explorer 2010).

Southern Enchanter's Nightshade (*Circaea lutetiana* ssp. *canadensis*)—State Vulnerable (S3). This species grows in mesic, nutrient-rich forests (Weakley 2008). It is considered vulnerable in South Carolina (NatureServe Explorer 2010).

Other Important Species

This subsection discusses commercially and recreationally valuable species, species that are essential to the maintenance and survival of commercially or recreationally valuable species that are rare, species critical to the structure and function of the local terrestrial ecosystem, biological indicator species, pest and nuisance species, and invasive species. Noted are occurrences of such species on and in the vicinity of the Lee Nuclear Station site, the Make-Up Pond C site, the two proposed transmission-line corridors, and the railroad-spur corridor.

Commercially and Recreationally Valuable Species. Forests on the Lee Nuclear Station, the Make-Up Pond C site, the two proposed transmission-line corridors, and the railroad-spur corridor contain harvestable timber. Some stands were harvested previously. Commercial timber harvest will likely be prohibited following construction of the proposed Units 1 and 2 (Duke 2009c).

Recreationally hunted game potentially occurring in the project area include black bear, beaver, bobcat (*Lynx rufus*), coyote, deer, feral hog (*Sus scrofa*), gray fox (*Urocyon cinereoargenteus*) and red fox (*Vulpes vulpes*), mink (*Mustela vison*), muskrat (*Ondatra zibethicus*), nine-banded armadillo (*Dasypus novemcinctus*), opossum, river otter (*Lutra canadensis*), rabbit, raccoon, striped and spotted skunks (*Mephitis mephitis* and *Spilogale putorius*), squirrel, and weasel (*Mustela* spp.). Recreationally hunted birds potentially occurring on or in the vicinity of the Lee Nuclear Station site include waterfowl (ducks and geese), bobwhite quail, mourning dove, rails (members of the family Rallidae), American coot (*Fulica americana*), gallinule (*Porphyrula martinica*), ruffed grouse, American crow, wild turkey, common snipe, and American woodcock (Duke 2009c).

Based on the availability of suitable habitat, all of these species are likely to inhabit the project area but are also common elsewhere. After Duke sold the Cherokee Nuclear Station site, subsequent owners apparently hunted upland birds and other game as evidenced by spent shotgun shells observed at numerous locations during field reconnaissance conducted in 2006. However, recreational hunting and trapping will likely be prohibited on the Lee Nuclear Station site in the future (Duke 2009c).

Essential Species. There are no species that are considered to be essential to the maintenance and survival (e.g., through a trophic relationship) of the Federally listed or State-ranked species known to occur in the project footprint (Table 2-9). There are no commercially or recreationally valuable species in the vicinity (Duke 2009c).

Critical Species. There are no species that are considered to be critical to the structure and function of the local terrestrial ecosystem in the project area (Duke 2009c).

Biological Indicator Species. Biological indicators are usually species or groups of species that can be used to assess environmental conditions. These may be relatively common species that are sensitive to environmental changes, or they could be Federally listed or State-ranked species and other rare species. Examples of potential bioindicator groups include the rare plant species within the Make-Up Pond C study area. These species, which are described in Sections 2.4.1.2 and 2.4.1.6, are primarily indicative of relatively undisturbed mixed hardwood forests that occur in significant natural areas (Gaddy 2009). The salamanders observed in the Make-Up Pond C study area are another example of an indicator species because they are wetland dependent (Duke 2009b).

Nuisance Species. Numerous vertebrate species can become pests, including raccoons, deer, bears, moles, voles, beavers, feral hogs, gophers, snakes, crows, pigeons, starlings, and nutria. At least some of these species inhabit the project area (Duke 2009c).

After the Lee Nuclear Station is fenced, mammals (e.g., deer, feral hogs, and beavers) may become trapped within the fenced area, potentially leading to habitat damage and nuisance issues. If this occurs, Duke will attempt to remove the animals using either lethal or non-lethal methods (Duke 2009c).

Other pests include insects such as mosquitoes, ticks, wasps, bees, termites, bark beetles, and fire ants. Some of these pests (e.g., mosquitoes and wasps) present a nuisance as well as a health and safety risk to humans. Others (e.g., the southern pine beetle) can be devastating to native and planted pines. Although there are many pine forest areas on the Lee Nuclear Station site, no evidence of pine beetles was observed during field reconnaissance. Primary disease vectors onsite appear to be mosquitoes, which can transmit the West Nile virus and ticks, which can carry Lyme disease (Duke 2009c).

Important Terrestrial Habitats

Important habitats are defined as sanctuaries, refuges, and/or preserves that have been set aside and protected by State and/or Federal agencies or organizations. Critical habitats are those designated to support Federally listed threatened or endangered species (NRC 2000a).

Wildlife Sanctuaries, Refuges, and Preserves

There are no national or state wildlife refuges, management areas, or other designated wildlife sanctuaries or preserves in the project area (Duke 2009c).

Unique and Rare Habitats or Habitats with Priority for Protection

Kings Mountain National Military Park is located in Cherokee and York Counties about 10 mi northeast of the Lee Nuclear Station site. According to White and Govus (2005), the park covers 3946 ac and is composed primarily of forest and woodland. Elevations range from 650 to 1045 ft. Kings Mountain National Military Park is surrounded on two sides by Kings Mountain State Park. All creeks in the park flow into the Broad River or one of its tributaries (White and Govus 2005).

Kings Mountain National Military Park, created by an act of Congress in 1931, is known for its importance in the Revolutionary War. Between the time of the war and the establishment of the park, the area served as pastureland, cropland, timberland, and sites for homes. However, much of the park has been recovering from human disturbance for at least 50 years, and thus contains significant natural resources. For example, it harbors 508 plant species, among them the Georgia aster, a Federal candidate plant species also found in the Make-Up Pond C study area and 12 State-ranked (S3 [vulnerable] or above) plant species, some of which are also found in the Make-Up Pond C study area (e.g., southern enchanter's nightshade, Canada moonseed, southern adder's-tongue fern, single-flowered cancer root). In addition, Kings Mountain National Military Park harbors four highly ranked ecological associations (global conservation status rank G3 [vulnerable] and above), one of which also occurs in the Make-Up Pond C study area (Piedmont beech/heath bluff [unique identifier CEGL004539]), which is considered imperiled (global conservation status rank of G2) (White and Govus 2005). The fact that Kings Mountain National Military Park (3946 ac) is almost twice the size of the Make-Up Pond C study area (2110 ac) and harbors a comparable number of plant species (i.e., 508 in Kings Mountain National Military Park, 426 in the Make-Up Pond C study area), highly ranked ecological associations (i.e., 4 in Kings Mountain National Military Park, 4 in the Make-Up Pond C study area), and State-ranked plant species (i.e., 12 in Kings Mountain National Military Park, 5 in the Make-Up Pond C study area) supports the SCDNR's description of the London Creek watershed as having relatively high habitat integrity (SCDNR 2011b).

Significant natural areas and several noteworthy plant communities of interest to the State of South Carolina in the Make-Up Pond C study area, are described in Section 2.4.1.2.

Critical Habitat

No areas designated by the FWS as critical habitat exist at the Lee Nuclear Station site, the Make-Up Pond C site, the two proposed transmission-line corridors, or the railroad-spur corridor (FWS 2008a).

Travel Corridors

The relatively continuous, undisturbed bottomland mixed hardwood and mixed hardwood-pine forest habitats along London Creek and its tributaries provide vital travel corridors for many wildlife species between Lake Cherokee and the Broad River. This corridor functions as part of the greater Broad River travel corridor. Most notable among the wildlife that use this corridor are neotropical and other migratory birds. For example, the bottomland hardwood forest and mixed pine-hardwood forest had the highest avian species diversity of any habitats sampled in the Make-Up Pond C study area. Further, the highest avian diversity in the Make-Up Pond C study area was observed during spring migration (DTA 2008b). These data support use of London Creek habitats as a travel corridor for neotropical and other migratory birds.

Recreation Areas

There are 19 ecologically oriented recreational areas in the vicinity of the Lee Nuclear Station, including outdoor recreation areas, hiking trails, campgrounds, public fishing sites and piers, heritage preserves, boat ramps, and wildlife viewing areas (Duke 2009c). However, only two of these areas that are potentially important for habitat and wildlife occur within 10 mi of the Lee Nuclear Station site: Lake Cherokee (discussed in Section 4.3.1.2 in relation to Make-Up Pond C), and the Broad Scenic River (discussed in Section 7.3.1 in relation to cumulative impacts).

2.4.1.7 Terrestrial Monitoring

As indicated in the first paragraph of Section 2.4.1.6, many terrestrial ecology studies were conducted recently for the Lee Nuclear Station Units 1 and 2 COL ER and previously for the Cherokee Nuclear Station ER. The specific locations of survey routes, transects, points, etc., are provided in the individual study reports referenced in Important Terrestrial Species in Section 2.4.1.6, and in the study reports referenced in relation to wetland delineation and vegetation cover type mapping in Sections 2.4.1.1 through 2.4.1.4. The general level of effort expended, temporal coverage, and results of these surveys with regard to general biota, wetland delineation, and vegetation cover type mapping are discussed in Sections 2.4.1.1 through 2.4.1.4. The results of these surveys with regard to Federally listed and State-ranked species are discussed in Section 2.4.1.6. Federally listed and State-ranked species that potentially could occur and those which were observed on and in the vicinity of the Lee Nuclear Station, the Make-Up Pond C site, the two proposed transmission-line corridors, and the railroad-spur corridor are provided in Table 2-9.

The NRC staff reviewed the available information relative to the terrestrial ecological monitoring program and the data collected by the program. The NRC staff concludes that the program provides adequate data to characterize and track impacts on the terrestrial ecological environment for the Lee Nuclear Station, the Make-Up Pond C site, the two proposed transmission-line corridors, and the railroad-spur corridor in support of the acceptance criteria outlined in the NRC's Environmental Standard Review Plan (NRC 2000a) and recent updates (hereinafter referred to as the ESRP).

2.4.2 Aquatic Ecology

This section describes the aquatic environment and biota in the vicinity of the Lee Nuclear Station site and other areas likely to be affected by the building, operating, or maintaining of the proposed Units 1 and 2. This section describes the spatial and temporal distribution, abundance, and other structural and functional attributes of biotic assemblages on which the proposed action could have an impact. Further, this section identifies "important" or irreplaceable aquatic natural resources and the location of natural preserves that might be affected by the proposed action.

The major aquatic environments within the vicinity of the Lee Nuclear Station site include the Broad River; Ninety-Nine Islands Reservoir; onsite impoundments (i.e., Make-Up Pond A, Make-Up Pond B, and Hold-Up Pond A); the proposed Make-Up Pond C study area on London Creek; and various other waterbodies, including wetlands surrounding the onsite impoundments, farm ponds, and tributaries to the Broad River and London Creek (Duke 2009c). Figure 2-7 provides an overview of the waterbodies discussed in this section. The Broad River is the largest waterbody near the site and is a State navigable water, subject to permitting requirements pursuant to South Carolina R.19-450 under the State Navigable Waters Act (SCDNR 2008a). London Creek and several of its tributaries would be dammed and inundated to create the new supplemental water reservoir (Make-Up Pond C).

2.4.2.1 Aquatic Resources – Site and Vicinity

Aquatic resources associated with the Lee Nuclear Station site, Make-Up Pond C area, railroad-spur corridor, and two offsite transmission-line corridors include a total of 31.184 ac of Federally defined jurisdictional freshwater wetlands, 284.4 ac of open waters, and 167,071.01 linear ft of streams or other waters of the United States subject to the jurisdiction of the USACE as well as 10.61 ac of non-jurisdictional features (i.e., open water ponds not subject to jurisdiction by the USACE) (USACE 2013a). No aquatic resources in areas would be affected by the offsite road improvements.

As part of its Joint Permit Application, Duke conducted functional assessments for jurisdictional streams within the boundaries of its Department of the Army permit application (Duke 2011h) according to the USACE Charleston District Guidelines (USACE 2010a). These activities were performed to assess the stream resource functions lost from proposed unavoidable impacts to waters of the United States that would result from the development of the Lee Nuclear Station and help determine mitigation credits required to offset the net loss of waters of the United States and their associated functional benefits.

A total of 250 stream reaches were assessed in the field (i.e., the Lee Nuclear Station site, Make-Up Pond C area, railroad-spur corridor, and the two offsite transmission-line corridors) during April and June 2011, based on a number of functional descriptors, including stream width and depth, epifaunal substrate, embeddedness, velocity/depth, sediment, channel flow, channel alteration, frequency of riffles, bank stability, vegetation, and riparian zone. Scores for each of the functional descriptors were converted to give one of the four existing conditions: fully functional (functioning naturally as in an undisturbed condition), partially impaired (partial loss of functionality due to disturbance, but functional recovery is expected to occur through natural processes), impaired (partial loss of functionality due to disturbance which would require restoration activities to facilitate recovery), or very impaired (loss of most functionality due to disturbance and functional recovery would require a significant restoration effort) (USACE 2010a).

On the Lee Nuclear Station site, most stream reaches were partially impaired, followed by reaches that were fully functional. A small number of stream reaches (less than 10 percent) were impaired. No stream reaches were very impaired. Within the Make-Up Pond C permit area, nearly half the stream reaches were partially impaired and over one-quarter of the reaches fully functional. The remainder of the stream reaches in the Make-Up Pond C permit area were impaired; none were very impaired. Within the railroad-spur corridor permit area, slightly over half the stream reaches were fully functional and slightly under half were partially impaired. Only one stream reach was impaired and none were very impaired. Finally, along the proposed west and east transmission-line corridors, most stream reaches were classified as partially impaired (roughly 60 percent). The number of reaches that were fully functional slightly outweighed the number of stream reaches that were considered impaired. None were very impaired.

Functional assessments of open waters were not performed. Instead, Duke assumed that all open water areas present within the permit area were fully functional (Duke 2011h).

Since 1991, the 15.3-mi section of the Broad River between Ninety-Nine Islands Dam and the downstream confluence with the Pacolet River has been designated as a State Scenic River (SCDNR 2006a). The Broad Scenic River is a stretch of undeveloped riverfront with diverse riparian habitat that is crossed by only one highway bridge. A voluntary, cooperative community-based process is used by the SCDNR, landowners, and other community stakeholders to accomplish river conservation goals (SCDNR 2006a). According to Duke's ER, the current uses of this river section include fishing, boating, rafting, tubing, swimming, nature study, photography, and bird watching (Duke 2009c). According to *The South Carolina Rivers Assessment* (South Carolina Water Resources Commission 1988) and summarized in the *Broad River Management Plan, 2003 Update* (Broad Scenic River Advisory Council 2003), "the Broad River is an outstanding river of regional significance in seven categories: 1) Historic and Cultural, 2) Industrial, 3) Inland Fisheries, 4) Recreational Fishing, 5) Timber Management, 6) Water Supply, and 7) Wildlife Habitat."

Other than the 15.3-mi stretch of the Broad Scenic River below Ninety-Nine Islands Dam, none of the abovementioned waterbodies are designated by the State of South Carolina as unique or critical aquatic habitat. The nearest preserve is the SCDNR's Pacolet River Heritage Preserve, which is located approximately 17 mi southwest of the Lee Nuclear Station site (Duke 2009c). The Pacolet River joins the Broad River approximately 15.3 mi downstream of Ninety-Nine Islands Dam, at the lower end of the Broad Scenic River. The preserve is located approximately 20 mi upstream on the banks of the Pacolet River. It covers 278 ac in Spartanburg County and provides opportunities for recreational fishing, plant and wildlife viewing, and exploring two historical Native American soapstone quarries (SCDNR 2008b). Direct impacts to the Pacolet River Heritage Preserve are unlikely because of its distance from the Lee Nuclear Station site.

Other heritage preserves listed in the Duke ER include Peters Creek (approximately 20 mi southwest of the Lee Nuclear Station site) and Rock Hill Blackjacks (approximately 30 mi southeast) (Duke 2009c). Peters Creek, a tributary of the Pacolet River, is not expected to be affected by the proposed action because of its distance from the proposed site. Rock Hill Blackjacks is outside the Upper Broad River basin and is unlikely to be affected by the Lee Nuclear Station site (Duke 2009c).

In 2008, several sites near the Lee Nuclear Station site were listed as impaired for use by aquatic life by South Carolina under Section 303(d) of the Clean Water Act (SCDHEC 2008b). Three sites were listed because levels of copper exceeded State standards more than once in 5 years (Cherokee Creek, a tributary above Cherokee Falls Dam; Thicketty Creek, a tributary below Ninety-Nine Islands Dam; and the mainstem Broad River above Cherokee Falls Dam, 4 mi northeast of Gaffney). Two sites on tributaries to the Broad River (Cherokee Creek, above Cherokee Falls Dam, and Gilkey Creek, below Ninety-Nine Islands Dam) were listed because the composition and functional integrity of macroinvertebrate populations was compromised.

No critical habitat has been designated by the FWS or NMFS in the vicinity of the Lee Nuclear Station site (FWS 2008a; Duke 2009b).

Broad River and Ninety-Nine Islands Reservoir

The Broad River originates in North Carolina and flows for approximately 110 mi through South Carolina's Piedmont Watershed until it merges with the Saluda River to form the Congaree River (Bettinger et al. 2003). The Lee Nuclear Station site would be located on the Broad River immediately upstream from Ninety-Nine Islands Dam along the part of the river known as Ninety-Nine Islands Reservoir. This reservoir, which would provide source water and serve as the receiving waterbody, is the largest and most important aquatic resource in the vicinity of the site.

Ninety-Nine Islands Reservoir is a 4-mi-long hydroelectric reservoir above Ninety-Nine Islands Dam. The reservoir has limited storage capacity, estimated between 1691 ac-ft (Duke 2009c) and 2300 ac-ft (Wachob et al. 2009). The smaller estimate is based on the loss of storage capacity caused by significant sedimentation since the dam was completed in 1910 (Taylor and Braymer 1917; Duke 2009c).

Ninety-Nine Islands Reservoir is a dynamic system undergoing change through the process of floods, scouring, low flow, and sedimentation. Currently, the reservoir consists of the main river and two backwater regions to either side of the river channel (Duke 2009c).

The main channel is broad (approximately 180 to 360 ft wide) and characterized as "often turbid" (Cloutman and Harrell 1987). Substrate composition is primarily sand with some gravel beds or rubble outcrops (Duke 2009b; Cloutman and Harrell 1987). A bathymetric survey of the impoundment conducted in September 2006 documented a mean reservoir depth of just 9.2 ft (Duke 2013a). The maximum recorded depth was 35.2 ft at the site of the proposed raw water (Broad River)-intake structure. Because most of the reservoir is so shallow, even minor fluctuations in water levels from human activities (e.g., water use and release) or natural events (e.g., drought or significant rainfall) can result in significant changes to the surface area of the reservoir (Duke 2013a).

The two backwater areas are separated from the main channel by areas of sediment deposition. Large areas of streambed have been filled by sediment deposits and stabilized with vegetation. The shallow backwater areas parallel to the main channel contain large deposits of river-borne sediments deposited during flood conditions (Duke 2009c). Little emergent vegetation is present in the mainstem or backwater areas; fallen trees and riparian vegetation are present along the shore.

Seven hydroelectric projects are located on the South Carolina portion of the Broad River. Only Columbia Dam (furthest downstream) currently has fish-passage facilities (Figure 2-17) (NCWRC 2008a). Under the *Santee River Basin Accord for Diadromous Fish Protection, Restoration, and Enhancement*, biological triggers for initiating the development of new fish-passage projects at upstream dams have been determined (SRBA 2008). Ninety-Nine Islands Dam would be the fourth dam to include fish-passage facilities, should downstream fish-passage projects prove successful at restoring anadromous fish, such as American Shad (*Alosa sapidissima*) and Blueback Herring (*A. aestivalis*). Because of "no sooner than" dates linked to the *Santee River Basin Accord* (SRBA 2008), fish-passage facilities at Ninety-Nine Islands Dam are unlikely to be installed before 2020; however, it is possible that a fishway could be installed during the operational period of the proposed Lee Nuclear Station Units 1 and 2, should the NRC grant the requested COLs. Currently, the operating license for Ninety-Nine Islands Dam includes a requirement for continuous minimum flows of 966 cfs (January through April), 725 cfs (May, June, and December), and 483 cfs (July through November) or the inflow amount, whichever is less (Duke 2008m). Minimum flows help stabilize instream water temperatures,

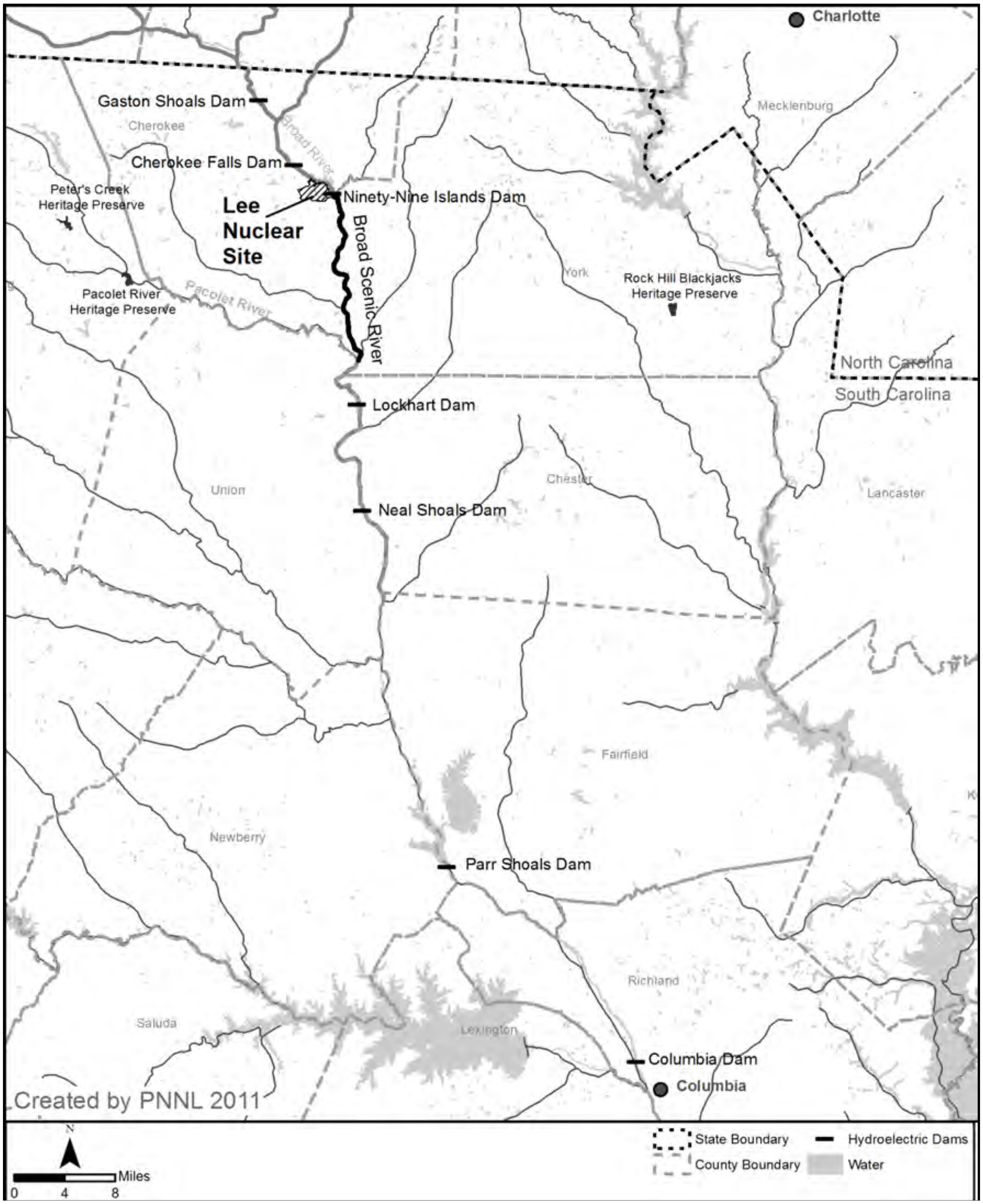

Figure 2-17. Hydroelectric Projects on the Broad River, the Broad Scenic River, and Heritage Preserves in South Carolina

provide reliable habitat for aquatic life, and guarantee some predictable water levels for recreational purposes. An Order Amending License Article 402 (which pertains to these minimum flows) was issued to Duke on November 15, 2011 (FERC 2011c) (see Section 2.3.1.1). Section 5.2.1, Hydrological Alterations (during nuclear station operations), provides more detail.

Attached Algae and Phytoplankton

Duke Power Company sampled the Broad River for algae, plankton, and aquatic macrophytes in the 1970s before construction of the unfinished Cherokee Nuclear Station (Duke Power Company 1974a, b, c; Duke 2008a). In the mid-1970s, researchers studying grab samples and artificial substrates (glass slides) found that attached algae (periphyton) in the Broad River were largely composed of diatoms, with some blue-green algae species also present (NRC 1975a).

Sampling for drifting algae (phytoplankton) by Duke Power Company in the 1970s indicated that diatoms were numerically dominant (NRC 1975a). Phytoplankton was most abundant in spring and summer and least abundant in fall and winter. Blue-green and green algae were also present. The highest densities were in the backwater areas of the reservoir, while lower densities were recorded in the main river channel. These records from the 1970s are the most recent sampling data available.

Zooplankton

In the 1970s, net tow surveys indicated that rotifers dominated the zooplankton population in the main channel of the Broad River except during the coldest parts of the year when copepods and cladocerans predominated (NRC 1975a). In Ninety-Nine Islands Reservoir, zooplankton densities were much higher, and while rotifers were still dominant, copepods and cladocerans made up a larger proportion of the reservoir community. In the lentic environment of the backwater areas, zooplankton is the primary link between primary production and higher trophic levels. These records from the 1970s are the most recent sampling data available.

Aquatic Macrophytes

During the 1970s, marsh areas associated with the backwater areas of Ninety-Nine Islands Reservoir also supported substantial populations of native emergent aquatic macrophytes, such as broadleaf cattail (*Typha latifolia*) and broadleaf arrowhead (*Sagittaria latifolia*) (NRC 1975a). However, Cloutman and Harrell (1987) observed that emergent macrophytes were not present along the Broad River within 4 km of the Lee Nuclear Station site (Cloutman and Harrell 1987). Likewise, the NRC staff did not observe emergent vegetation during a site visit conducted in April and May 2008.

Benthic Invertebrates

In the main channel of the Broad River, it is the benthic community that is the predominant link between primary production, detritus, and higher trophic levels, such as fish. During surveys conducted in the 1970s with Surber samplers, Ekman grabs, and Ponar grabs, chironomids (non-biting midges), phantom midges (*Chaoborus punctipennis*), oligochaetes (worms), and Gomphidae (clubtail dragonflies) were present in sandy areas of the Broad River above and below Ninety-Nine Islands Reservoir while Trichoptera (caddisflies) and Ephemeroptera (mayflies) were more abundant in rocky substrate (NRC 1975a). Densities of benthos from the rocky substrates were greater than the densities sampled from the sandy substrate. There were no seasonal changes in benthic species composition. Species composition in the reservoir was similar to that of the sandy portions of the river; however, densities of benthic invertebrates in the reservoir were higher than densities in the river above and below the reservoir.

Duke conducted macroinvertebrate sampling at five stations in April, August, and October 2006 (Duke 2008a). One station was above Ninety-Nine Islands Reservoir just below Cherokee Falls Dam (Station 465), two stations were in Ninety-Nine Islands Reservoir just above and below the location of the proposed Lee Nuclear Station cooling-water intake (Stations 463 and 460), one station was near the proposed cooling-water discharge (Station 459), and the last station was downstream of Ninety-Nine Islands Dam in the vicinity of the Broad River's confluence with Kings Creek (Station 453) (Figure 2-18) (Duke 2009c). The *Standard Operating Procedures for Benthic Macroinvertebrates* (NCDENR 2006) were used, with the appropriate seasonal corrections. This method is accepted by the SCDNR and provides an indication of the biological integrity of rivers and streams. Benthic macroinvertebrates are useful indicators of water quality because they are sensitive to a wide variety of potential pollutants, and their sedentary nature allows researchers to monitor spatial and temporal changes in water quality. In clean water, species that tolerate poor water quality are present, along with species that do not tolerate pollution. As the water quality degrades, the pollution intolerant species decrease in number or die off. Thus, a greater number of species collected (i.e., total taxa) generally indicates better water quality. Another metric, total Ephemeroptera-Plecoptera-Trichoptera (EPT) taxa, measures the number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) collected. The EPT species are generally those most intolerant of pollution or of poor water quality. A biotic index uses a region-specific sorting system to rank benthic species according to their pollution tolerance. The final ranking using the NCDENR (2006) method results in a bioclassification rating of the sample location's overall water quality as "excellent," "good," "good-fair," "fair," or "poor." Criteria have been developed to translate macroinvertebrate bioclassifications to use support ratings. Rankings in the excellent to good-fair range equate to supporting ratings. Fair ratings translate to impaired ratings when a second sample within 12 to 24 months is rated fair or poor, but translates to supporting when the second sample is rated good-fair to excellent. Between the first and second sampling, the location is considered not rated. A poor sample automatically translates to an impaired rating (NCDENR 2003).

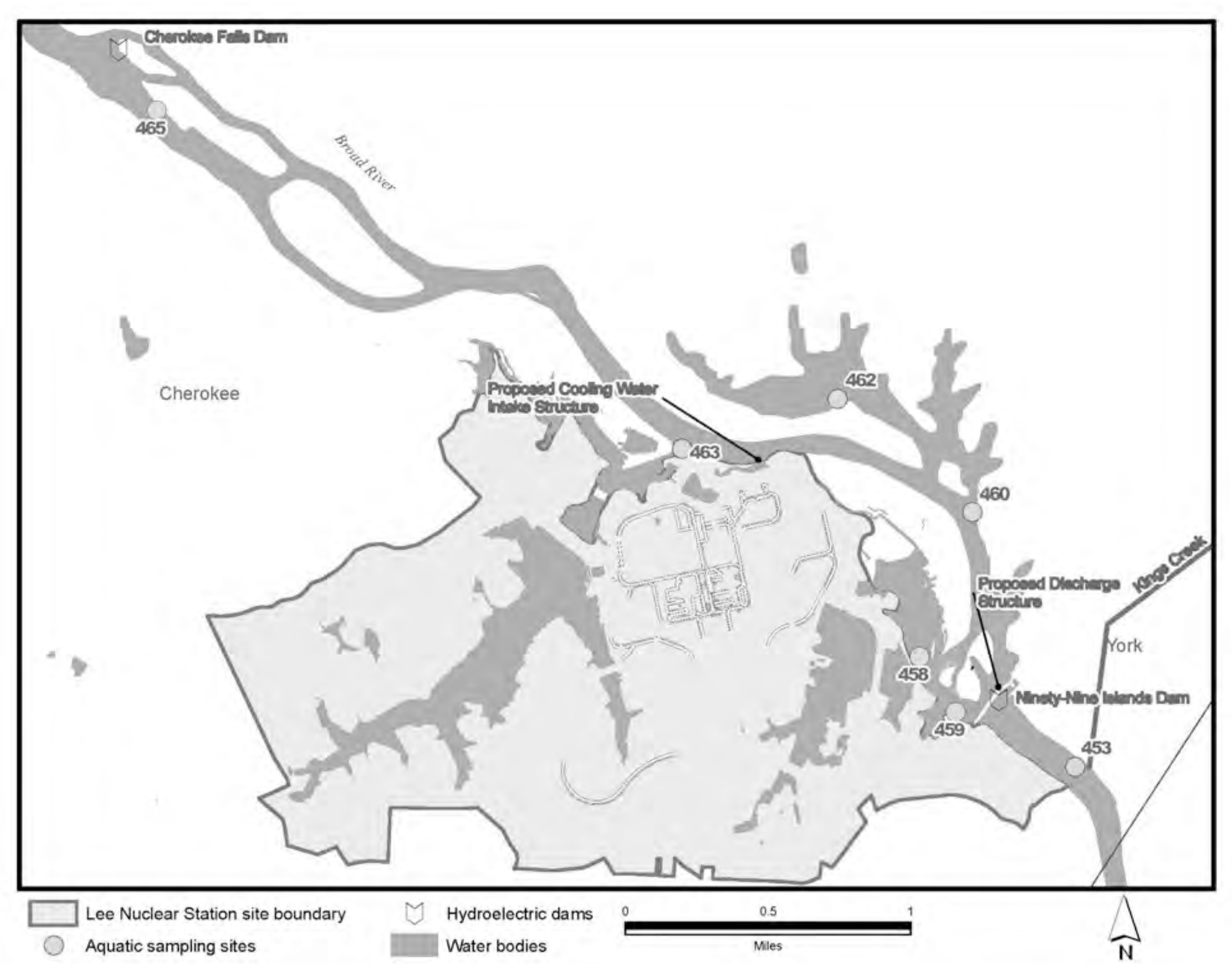

Figure 2-18. Duke Aquatic Sampling Sites, 2006 (adapted from Duke 2009c)

Total taxa per sampling trip ranged from a low of 18 in August 2006 at the site just upstream from the proposed cooling-water intake (Station 463) to a high of 86 in April 2006 at a site just downstream from Cherokee Falls Dam (Station 465). The maximum number of EPT taxa found during any one sampling period was 26, in April 2006 at a site just below Cherokee Falls Dam (Station 465), approximately 3 mi from the river water intake. Overall, the total number of taxa found was highest at the two sites outside Ninety-Nine Islands Reservoir, with 86 taxa found just below Cherokee Falls Dam (Station 465) and 67 taxa found just below Ninety-Nine Islands Dam (Station 453) (Table 2-10). Bioclassification scores were good and good/fair at the sites outside the reservoir, and either fair or poor in the reservoir, including those areas near the proposed cooling-water intake (Station 463) and proposed discharge structure (Station 459). Substrate composition is the most likely reason for the low bioclassification scores within the reservoir. As indicated in the 1975 surveys (NRC 1975a), the EPT taxa generally prefer rockier substrate, which is not common within the reservoir.

Table 2-10. 2006 Macroinvertebrate Surveys of Total Taxa in the Broad River, South Carolina

	Station 465 (just below Cherokee Falls Dam)	**Station 463 (just upstream of proposed cooling-water intake)**	**Station 460 (downstream of proposed cooling-water intake)**	**Station 459 (near proposed cooling-water discharge)**	**Station 453 (below Ninety-Nine Islands Dam)**
April	86	40	47	42	67
August	48	18	21	33	51
October	68	35	26	36	58

Source: Duke 2008a

Apparently, no surveys for mussels were conducted in the 1970s as part of the original licensing activities for the Cherokee Nuclear Station. In 2002, the SCDNR surveyed six sites for mussels on the Broad River between Gaston Shoals (RM 91) and the Columbia Dam (RM 2) (Bettinger et al. 2003). No sample sites were located between Cherokee Dam and Ninety-Nine Islands Dam (Figure 2-18). Only two identifiable live species, the eastern elliptio (*Elliptio complanata*) and eastern creekshell (*Villosa delumbis*), and one live group of mussels from the yellow lance mussel complex (*E. lanceolata*) were collected. Relic shells from seven species were found, but the *Elliptio* spp. in the South Carolina portion of the Broad River are apparently not well known and could not be verified (Bettinger et al. 2003). Overall, mussels were found to be more abundant and diverse in the lower river than in the upper river (Bettinger et al. 2003).

In 2006, Duke conducted a search for mussels in the vicinity of the Lee Nuclear Station site using a combination of diving with self-contained underwater breathing apparatus, snorkeling, and bathyscope (Duke 2009c). A total of 14 hours were spent searching 11 sites in the mainstream Broad River (upstream and downstream of Ninety-Nine Islands Dam) and in the onsite ponds. Only one Carolina lance (*E. angustata*) and one eastern elliptio were found, both in the Ninety-Nine Islands Dam tailrace (Duke 2009c). Some potential mussel habitat was observed in the faster flowing sections of the river just below Cherokee Falls Dam and just below Ninety-Nine Islands Dam.

Fish

<u>1970s</u>

In the 1970s, fish were first sampled with backpack and boat electrofishing gear, seines, fyke nets, and trammel nets (Duke Power Company 1974a, b, c). In follow-on studies, experimental gill nets with three mesh sizes also were used to sample adult fish (Duke 2008a). Twenty-four fish species were collected in the mainstem Broad River outside the impounded area by Duke Power Company in the early 1970s (NRC 1975a). Cyprinids (minnows), which are important forage fish for game species, numerically dominated the catch at approximately 75 percent of the total fish captured. Centrarchids (sunfish) and clupeids (shad) accounted for a smaller proportion of the catch. Few ictalurids (catfish) were captured in the river.

Sampling in the backwater areas of Ninety-Nine Islands Reservoir in the 1970s produced 15 fish species typical of a lake-type fish community (NRC 1975a). Centrarchids, including Largemouth Bass (*Micropterus salmoides*), Bluegill (*Lepomis macrochirus*), and crappie (*Pomoxis* spp.) were numerically dominant. Catfish, another target of recreational fishers, were also present. Forage species collected from the reservoir included Threadfin Shad (*Dorosoma petenense*), Gizzard Shad (*D. cepedianum*) and Golden Shiner (*Notemigonus crysoleucas*). The Common Carp (*Cyprinus carpio*) and Quillback (*Carpiodes cyprinus*) (a catostomid or sucker) accounted for the greatest biomass.

Ichthyoplankton were sampled in the 1970s by towing circular nitex nets or by allowing larval fish to drift into the nets where water was too shallow for towing (Duke 2008a). Duke Power Company sampled for fish larvae in the mainstream of the Broad River above and below Ninety-Nine Islands Dam and in one backwater area of Ninety-Nine Islands Reservoir in 1975 and 1976 (Duke 2008a). No more recent ichthyoplankton surveys have been conducted. Overall, fish larvae were much more common in the backwater area (approximately 1106/1000 yd^3) than in the mainstream river (approximately 53/1000 yd^3). The uneven distribution is a result of the spawning and rearing habitat preferences of the fish species in this river system.

The most common fish larvae taxa observed in the mainstream portion of the Broad River were shad, minnow, and catfish, with minor occurrences of sunfish, catostomids (suckers), Common Carp, Largemouth Bass, and Piedmont Darters (*Percina crassa*) (Duke 2008a). In 1975, Common Carp were most abundant in the mainstream at approximately 4.2/1000 yd^3, followed by suckers at approximately 3.9/1000 yd^3. In 1976, shad were most abundant in the mainstream at approximately 40.4/1000 yd^3.

The backwater areas of the reservoir had much higher densities of ichthyoplankton (Duke 2008a). Shad (*Dorosoma* spp.), sunfish, and crappie were the most common taxa. Shad, including Gizzard Shad and Threadfin Shad, were the most abundant larvae in the backwater area both years, averaging approximately 459/1000 yd^3 in 1975 and approximately 1063/1000 yd^3 in 1976.

<u>2000s</u>

In February, April, July, and October 2006, Duke sampled fish from four stations in Ninety-Nine Islands Reservoir (Stations 460 and 463 in the mainstem river; Stations 458 and 462 in backwater areas), and from one station downstream of the reservoir just below Ninety-Nine Islands Dam (Station 453) (Figure 2-18) (Duke 2009c). A boat-mounted electroshocker was used to perform the sampling except when water levels were too low for the boat below Ninety-Nine Islands Dam in July and October. A tote-mounted barge carrying the same electroshocker was used to complete those two surveys at Station 453. Sampling was standardized by shocking for 1000 seconds (16.7 minutes) per segment of shoreline. Two 328-ft (100-m) segments were sampled at each of these stations.

In April 2006, one site upstream of the reservoir near Cherokee Falls Dam, was sampled to target suckers utilizing the rocky shoals and riffles for spawning. The same boat-mounted electroshocker was used, but one 2000-second (33.4-minute) shock period was used. Only suckers were retained for identification, enumeration, and measurement at this station.

All fish collected in 2006 were identified to species, enumerated, and measured for total length. In all, 38 species and 1 hybrid were captured, comprising 6 fish families. In 2006, Duke collected 21 fish species in the impounded area of the Broad River, not including the backwater areas (Duke 2009c). Centrarchids dominated the catch at 87 percent of the total fish captured. Bluegill dominated the sunfish species, but other centrarchids captured included several Largemouth and Smallmouth Bass (*Micropterus dolomieu*). The remainder of the catch was composed of 6 percent cyprinids (minnows), nearly 3 percent each of clupeids (shad) and ictalurids (catfish), and less than 2 percent each of catostomids (suckers) and percids (darters). A Fantail Darter (*Etheostoma flabellare*), synonomous with the Carolina Fantail Darter (*Etheostoma brevispinum*) due to a recent name change, was also collected at Location 463 (just upstream from the proposed river intake structure). The V-lip Redhorse (*Moxostoma pappillosum*), a rare species in the Broad River, was captured by the SCDNR between Cherokee Falls and Ninety-Nine Islands Dam. The V-lip Redhorse fish was also captured just below Ninety-Nine Islands Dam by both the SCDNR and Duke (Bettinger et al. 2003; Duke 2009c). This species is not listed as threatened or endangered by the State, but is on the State's Priority Species List for consideration for protection (SCDNR 2005).

The Smallmouth Bass in the Broad River is a unique fishery in the Piedmont rivers in South Carolina. The SCDNR introduced the species in 1984 to increase and diversify sport fishing in the State (Bettinger et al. 2003). SCDNR surveys of the Broad River in 2006 documented natural reproduction in the Smallmouth Bass population at three sites, including just below Cherokee Falls Dam (Bettinger et al. 2003).

Sampling in 2006 produced 18 species in the backwater areas of Ninety-Nine Islands Reservoir (Duke 2009c). Bluegill and other centrarchid species were still dominant, and all other species common in the 1970s were still present. Two catostomid species, the Notchlip Redhorse (*Moxostoma collapsum*) and Quillback, were captured in the backwater areas.

In the Broad River below Ninety-Nine Islands Dam during 2006, 27 fish species were identified. Cyprinids (minnows) and centrarchids (sunfish) were numerically dominant with 31 and 32 percent of the total fish captured, respectively. Catostomids (suckers) made up 20 percent of the catch while ictalurids (catfish) made up 16 percent. Percids (darters) and clupeids (shad) made up just over 2 percent of the fish captured below Ninety-Nine Islands Dam, combined.

Between 2000 and 2002, SCDNR's backpack electrofishing sampling station, located below Ninety-Nine Islands Dam, had the greatest mean species richness and second highest mean species diversity (Bettinger et al. 2003). Further, it was the only location where SCDNR captured Carolina Fantail Darters in the South Carolina section of the Broad River.

Overall, the number of fish species present in the vicinity of the proposed Lee Nuclear Station has not changed much over the past 30 years (Table 2-11). Species composition in the impounded area may have shifted from a cyprinid-dominated population to one that is more balanced between cyprinid and centrarchid species. However, the difference in sampling gear, locations, and seasons make direct comparisons impossible. According to the SCDNR, fish species composition appears to be comparable to what was previously known from the Broad River and that of similar-sized southern Piedmont rivers, such as the Catawba and Edisto Rivers (Bettinger et al. 2003).

Table 2-11. Species Richness[a]: Broad River Basin, South Carolina

	Collection Years:	**1974-1976[b]**	**2000-2002[c]**	**2003-2004[d]**	**2006[e]**
Number of Species (Number of Families)		43 (8)	50 (9)	45 (8)	40 (7)
Family Esocidae					
Esox americanus	Redfin Pickerel			X	
Esox niger	Chain Pickerel			X	
Family Lepisosteidae					
Lepisosteus osseus	Longnose Gar		X		
Family Clupeidae					
Dorosoma cepedianum	Gizzard Shad	X	X		X
Dorosoma petenense	Threadfin Shad	X	X		X
Family Cyprinidae					
Clinostomus funduloides	Rosyside Dace	X	X	X	
Ctenopharyngodon idella	Grass Carp		X		
Cyprinella pyrrhomelas	Fieryblack Shiner		X	X	X
Cyprinus carpio	Common Carp	X	X		X
Hybognathus regius	Eastern Silvery Minnow	X	X	X	
Hybopsis hypsinotus	Highback Chub	X		X	
Cyprinella labrosa[f]	Thicklip Chub	X	X		X
Cyprinella zanema[g]	Santee Chub	X	X	X	
Nocomis leptocephalus	Bluehead Chub	X	X	X	X
Notemigonus crysoleucas	Golden Shiner	X	X	X	X
Cyprinella chloristia[h]	Greenfin Shiner	X	X	X	X
Notropis cummingsae	Dusky Shiner			X	
Notropis hudsonius	Spottail Shiner	X	X	X	X

Table 2-11. (contd)

	Collection Years:	1974-1976[b]	2000-2002[c]	2003-2004[d]	2006[e]
Notropis lutipinnis	Yellowfin Shiner	X	X	X	
Cyprinella nivea[i]	Whitefin Shiner	X	X	X	X
Notropis petersoni	Coastal Shiner			X	
Notropis procne	Swallowtail Shiner	X		X	
Notropis scepticus	Sandbar Shiner	X	X	X	X
Semotilus atromaculatus	Creek Chub	X		X	X
Family Catostomidae					
Carpiodes cyprinus	Quillback	X	X		X
Carpiodes sp. cf. *velifer*	Highfin Carpsucker		X		
Catostomus commersonii	White Sucker	X	X	X	X
Erimyzon oblongus	Creek Chubsucker			X	
Hypentelium nigricans	Northern Hogsucker		X	X	X
Ictiobus bubalus	Smallmouth Buffalo		X		X
Moxostoma collapsum[j]	Notchlip Redhorse	X	X	X	X
Moxostoma macrolepidotum	Shorthead Redhorse	X	X		X
Moxostoma pappillosum	V-lip Redhorse		X		X
Moxostoma robustum[k]	Smallfin Redhorse	X			
Moxostoma rupiscartes[l]	Striped Jumprock	X	X	X	X
Moxostoma sp[m]	Brassy Jumprock		X	X	X
Family Ictaluridae					
Ameiurus brunneus[n]	Snail Bullhead	X	X	X	X
Ameiurus catus[o]	White Catfish	X	X		X
Ameiurus natalis	Yellow Bullhead			X	
Ameiurus platycephalus	Flat Bullhead	X	X	X	X
Ameiurus nebulosus[p]	Brown Bullhead	X			X
Ictalurus punctatus	Channel Catfish	X	X		X
Noturus insignis	Margined Madtom	X	X	X	X
Family Aphredoderidae					
Aphredoderus sayanus	Pirate Perch			X	
Family Poeciliidae					
Gambusia affinis	Mosquitofish	X			
Gambusia holbrooki	Eastern Mosquitofish		X	X	
Family Moronidae[q]					
Morone americana	White Perch		X		
Morone chrysops	White Bass	X	X		X
Family Centrarchidae					
Centrarchus macropterus	Flier		X	X	
Lepomis auritus	Redbreast Sunfish	X	X	X	X
Lepomis cyanellus	Green Sunfish		X	X	
Lepomis gibbosus	Pumpkinseed	X	X	X	X
Lepomis gulosus	Warmouth	X	X	X	X

Table 2-11. (contd)

	Collection Years:	1974-1976[b]	2000-2002[c]	2003-2004[d]	2006[e]
Lepomis macrochirus	Bluegill	X	X	X	X
Lepomis microlophus	Redear Sunfish	X	X	X	X
Micropterus dolomieu	Smallmouth Bass		X	X	X
Micropterus salmoides	Largemouth Bass	X	X	X	X
Pomoxis annularis	White Crappie	X			X
Pomoxis nigromaculatus	Black Crappie	X	X	X	X
Family Percidae					
Etheostoma brevispinum[r]	Carolina Fantail Darter	X	X	X	X
Etheostoma olmstedi	Tessellated Darter	X	X	X	
Etheostoma saludae	Saluda Darter			X	
Etheostoma thalassinum	Seagreen Darter	X	X	X	
Perca flavescens	Yellow Perch		X		X
Percina crassa	Piedmont Darter	X	X	X	X

(a) Hybrid species are not included in the table.
(b) Duke (2008a) including the Ninety-Nine Islands backwaters, the Broad River mainstem, and Broad River tributaries.
(c) Bettinger et al. (2003) including the SCDNR's entire sampling area of the Broad River in South Carolina.
(d) Bettinger et al. (2006) including the SCDNR's entire sampling area of the Broad River basin.
(e) Duke (2008a) in the vicinity of the proposed Lee Nuclear Station.
(f) Formerly *Hybopsis labrosa*
(g) Formerly *Hybopsis zanema*
(h) Formerly *Notropis chloristius*
(i) Formerly *Notropis niveus*
(j) The Notchlip Redhorse was formerly subsumed under the Silver Redhorse, *Moxostoma anisurum.* All previous accounts of southeastern Atlantic slope populations of Silver Redhorse actually describe the Notchlip Redhorse.
(k) Use of *Moxostoma robustum* in the Cherokee ER was a result of misidentification due to incomplete understanding of taxonomy of the species at that time.
(l) Formerly *Scartomyzon rupiscartes*
(m) Formerly *Scartomyzon* sp.
(n) Formerly *Ictalurus brunneus*
(o) Formerly *Ictalurus catus*
(p) Formerly *Ictalurus nebulosus,* Brown Catfish
(q) Sometimes attributed to Family Percichthyidae
(r) Formerly Fantail Darter (*Etheostoma flabellare*); the *E. flabellare brevispinum* subspecies was elevated to species level and is now known as *E. brevispinum* (Blanton and Schuster 2008).

Onsite Impoundments

There are three large man-made ponds located on the Lee Nuclear Station site (Figure 2-7). Make-Up Ponds A and B and Hold-Up Pond A were sampled for fish in April 2006 using a boat-mounted electroshocker. Segments of shoreline at all three ponds were sampled for 1000 seconds (16.7 minutes). Mussels were also sampled in 2006 (Duke 2009c).

Make-Up Pond A was built by Duke in the late 1970s by damming a backwater arm of Ninety-Nine Islands Reservoir. The pond is located east of the Lee Nuclear Station site and covers approximately 62 ac (Duke 2009c). The mean depth of the pond is approximately 26 ft, with a maximum depth near 57 ft. The cooling-water intake system would pump water from the Broad River into Make-Up Pond A to be used by the circulating-water system, replacing water lost from the cooling towers because of evaporation, drift, and blowdown. There is no commercial or recreational fishing in Make-Up Pond A. Fish captured by Duke in 2006 included Pumpkinseed (*Lepomis gibbosus*), Warmouth (*L. gulosus*), Bluegill, Largemouth Bass, Black Crappie (*Pomoxis nigromaculatus*), and White Catfish (*Ameiurus catus*) (Table 2-11). Bluegill was the heavily dominant species (Duke 2009c). Two mussel species were found in Make-Up Pond A, the eastern floater (*Pyganodon cataracta*) and the paper pondshell (*Utterbackia imbecillis*) (Duke 2009c). Both mussel species occur throughout South Carolina (Bogan and Alderman 2008) and have a global conservation status of G5, secure; neither has a State conservation status rank (SCDNR 2012a).

Make-Up Pond B was formed in the late 1970s by damming McKowns Creek, then a perennial stream. Make-Up Pond B is located west of proposed Lee Nuclear Station Units 1 and 2 and covers approximately 150 ac (Duke 2011h). The mean depth is approximately 31 ft, with a maximum depth near 60 ft. During the 2006 site evaluation, water was pumped into Make-Up Pond B to dewater the original excavation site for the unfinished Cherokee Nuclear Station (Duke 2009c). Under conditions of low flow in the Broad River (less than 538 cfs), water from Make-Up Pond B would be used as a backup water source to augment flow for the circulating-water system. Water would be pumped from Make-Up Pond B into Make-Up Pond A and then into the circulating-water system. Water also could be pumped from Make-Up Pond A or from the Broad River to Make-Up Pond B to refill the pond following any drawdown associated with low river flows. Fish captured in Make-Up Pond B by Duke in 2006 included Redbreast Sunfish (*Lepomis auritus*), Warmouth, Bluegill, Redear Sunfish (*L. microlophus*), Largemouth Bass, Black Crappie, Gizzard Shad, Common Carp, Snail Bullhead (*Ameiurus brunneus*), White Catfish, and Flat Bullhead (*A. platycephalus*) (Table 2-12) (Duke 2009c). Bluegill was the heavily dominant species (Duke 2009c). One mussel species, the eastern floater, was sampled from Make-Up Pond B (Duke 2009c).

Hold-Up Pond A was developed in the late 1970s by the construction of two dams within the backwaters of Ninety-Nine Islands Reservoir. It is located immediately north of the proposed Lee Nuclear Station and covers a surface area of approximately 4 ac (Duke 2009c) and is located immediately north of the proposed Unit 1 and 2 locations, between the reactors and the Broad River. Only Largemouth Bass, Redbreast Sunfish, Bluegill, and sunfish hybrids were captured by Duke in 2006, with Largemouth Bass being the dominant species (Table 2-12) (Duke 2009c). No mussels were collected from Hold-Up Pond A (Duke 2009c).

Several additional ponds are located at the Lee Nuclear Station site. These ponds were developed by previous landowners and cover a total surface area of approximately 32 ac (Duke 2009c). These small waterbodies were not sampled to inventory aquatic organisms.

Table 2-12. Fish Species Found in the Onsite Impoundments and London Creek

Scientific Name	Common Name	Make-Up Pond A[(a)]	Make-Up Pond B[(a)]	Hold-Up Pond A[(a)]	London Creek 2008-2009[(b)]	London Creek 2010[(c)]
Family Centrarchidae						
Lepomis auritus	Redbreast Sunfish		X	X	X	X
Lepomis cyanellus	Green Sunfish				X	X
Lepomis gibbosus	Pumpkinseed	X			X	X
Lepomis gulosus	Warmouth	X	X		X	X
Lepomis macrochirus	Bluegill	X	X	X	X	X
Lepomis microlophus	Redear Sunfish		X		X	
Micropterus salmoides	Largemouth Bass	X	X	X	X	X
Pomoxis nigromaculatus	Black Crappie	X	X			
Family Cyprinidae						
Clinostomus funduloides	Rosyside Dace				X	X
Cyprinella chloristia	Greenfin Shiner					X
Cyprinella nivea	Whitefin Shiner				X	X
Cyprinus carpio	Common Carp		X			
Hybopsis hypsinotus	Highback Chub				X	X
Nocomis leptocephalus	Bluehead Chub				X	X
Notropis chlorocephalus	Greenhead Shiner				X	X
Notropis scepticus	Sandbar Shiner				X	X
Semotilus atromaculatus	Creek Chub				X	X
Family Catostomidae						
Catostomus commersonii	White Sucker				X	X
Hypentelium nigricans	Northern Hogsucker				X	X
Moxostoma rupiscartes	Striped Jumprock				X	
Moxostoma sp.	Brassy Jumprock				X	
Family Ictaluridae						
Ameiurus brunneus	Snail Bullhead		X			
Ameiurus catus	White Catfish	X	X			
Ameiurus platycephalus	Flat Bullhead		X		X	X
Family Percidae						
Etheostoma olmstedi	Tessellated Darter				X	X
Family Poeciliidae						
Gambusia holbrooki	Eastern Mosquitofish				X	
Family Clupeidae						
Dorosoma cepedianum	Gizzard Shad		X			

(a) Duke (2009c)
(b) Coughlan (2009)
(c) SCDNR (2011b)

London Creek

London Creek is a tributary to the Broad River located offsite (Figure 2-7). It joins the Broad River within the upper reaches of Ninety-Nine Islands Reservoir. The proposed offsite Make-Up Pond C would be formed by impounding London Creek and some of its tributaries (Figure 2-7). If Make-Up Pond C receives the necessary authorizations from Federal and State regulatory agencies, it would inundate a portion of the approximately 3.76-mi-long London Creek to create an approximately 620-ac reservoir (Duke 2009b, 2011h). Its maximum depth would be approximately 116 ft, and the reservoir would have a total storage volume of approximately 22,000 ac-ft (Duke 2009b).

London Creek currently originates at the Lake Cherokee outfall, which is a drop-inlet spillway with a discharge pipe. Thus, Lake Cherokee provides flow to London Creek only when the lake is full. There is no minimum flow requirement for this outlet, and in times of severe or extreme drought, London Creek may cease to flow (Duke 2009b). Under normal conditions, London Creek is a shallow Piedmont stream with alternating pools and riffles that meanders through wooded bottomland. Duke (2009b) describes London Creek's instream habitat as including "shallow riffles with cobbles, pools, root masses, leaf packs, woody debris, smaller amounts of sand and silt substrate, and minor amounts of trash in places." A few small sections contain bedrock. Based on a survey it conducted May 2010 (SCDNR 2011b), the SCDNR characterized the London Creek physical conditions "as consistent with a reasonably high quality Piedmont stream, including a forested riparian corridor, good channel sinuosity and habitat (riffle/pool) diversity, and coarse, clean substrate composition."

Duke surveyed three stream segments of London Creek for fish using backpack electrofishing techniques in March and September of 2008 and 2009 (Coughlan 2009). Each segment was approximately 328-ft (100-m) long. Twenty-one species of fish were captured and identified (excluding hybrids) (Table 2-12). The most numerous species were cyprinids (minnows), followed by centrarchids (sunfish), and four other family groups. The species captured are typical of other Piedmont streams in the vicinity (Duke 2010f, g).

SCDNR used the South Carolina Stream Assessment protocol (Thomason et al. 2002) to sample 561 ft of London Creek in May 2010 (SCDNR 2011b). The SCDNR collected 18 fish species, including 1 species not collected by Duke in 2008 (Table 2-12). Thus, a total of 22 fish species were collected in London Creek surveys. Of these 22 species, 1 species, the Greenhead Shiner (*Notropis chlorocephalus*), is a South Carolina State conservation species of high priority and 3 are species of moderate priority: Greenfin Shiner (*Cyprinella chloristia*), Highback Chub (*Hybopsis hypsinotus*), and Flat Bullhead.

Macroinvertebrate species were surveyed by Duke in March and September of 2008 and 2009 and in June 2009 (Derwort and Hall 2009). Two mussel species were identified: native swamp fingernail clam (*Musculium partumeium*) and non-native Asiatic clam (*Corbicula fluminea*). The swamp fingernail clam, which is not a State species of conservation concern in South Carolina, was rare (1 to 2 individuals collected) to abundant (10 or more individuals collected) depending on the time of year and the individual sampling site. The Asiatic clam was also rare to abundant depending on time of year and sampling site. Duke collected crayfish during surveys in 2008 and 2009 (Derwort and Hall 2009). In 2010, the SCDNR borrowed and examined Duke's archived crayfish collections and, on three occasions, performed joint collections with Duke (SCDNR 2010b). Two stream-dwelling and one burrowing species of crayfish were collected (Derwort and Hall 2009; SCDNR 2010b). None of the three crayfish species collected from the London Creek area are of conservation concern in South Carolina (SCDNR 2006b). The Broad River spiny crayfish (*Cambarus spicatus*), which is of high conservation concern and is present in the Broad River drainage, was not collected in London Creek.

All macroinvertebrate samples collected by Duke in London Creek resulted in fair bioclassification scores in 2008 and mostly good-fair scores in 2009. The scores take into consideration species diversity, abundance, and pollution sensitivity. The sampling and scores were calculated using the North Carolina Department of Environment and Natural Resources' *Standard Operating Procedures for Benthic Macroinvertebrates*, which is accepted by the State of South Carolina (NCDENR 2006). Higher bioclassification scores and numbers of taxa in 2009 compared to 2008 were likely due to drought conditions that persisted during the 2008 sampling period followed by more normal rainfall in 2009 (Derwort and Hall 2009).

Other Waterbodies

There are 100,398.07 linear ft of jurisdictional stream reaches located within the Make-Up Pond C area, including London Creek and Little London Creek (USACE 2013a). Because Little London Creek joins London Creek downstream of the proposed impoundment site, it would remain intact.

There are 21 stream crossings and 5942.14 linear ft of stream reaches within the railroad corridor jurisdictional determination boundary. Two small areas of jurisdictional open water ponds, totaling 0.41 ac, are also located within the railroad corridor (USACE 2013a). The existing railroad-spur corridor that would be upgraded and used for the proposed Lee Nuclear Station crosses London Creek and seven other tributaries (Figure 2-7).

Thirteen small farm ponds covering 18.54 ac also occur in the vicinity of the proposed Make-Up Pond C. Eleven of these ponds, encompassing 17.18 ac, are considered jurisdictional waters of the United States (USACE 2013a). It is assumed that the ponds were used to water livestock and provide recreational fishing opportunities for the private landowners. Most of the ponds would be inundated by the impoundment; all would be breached and drained (Duke 2009b).

Duke sampled seven of the farm ponds in the vicinity of the proposed Make-Up Pond C using boat-mounted electrofishing equipment during April 2010 (Duke 2010d). Two ponds contained no fish. Two ponds contained only Largemouth Bass, and two ponds contained Largemouth Bass and hybrid sunfish. One pond contained Bluegill, Redear Sunfish, hybrid sunfish, and Largemouth Bass. This pond was isolated from pasture land and was the only pond with a wooded shoreline. Length-frequency distributions indicated that the Largemouth Bass were small and of marginal fishing value. Several large sunfish were sampled from the wooded pond, but collection rates were very low. Duke anticipates the small size of the bass and limited number of sunfish will preclude relocation of fish, but it will consult with SCDNR before draining the ponds (Duke 2010d).

As discussed in Section 2.4.1.1, the Lee Nuclear Station site contains 12.52 ac of jurisdictional wetlands (USACE 2013a). In addition, the Make-Up Pond C area contains 7.43 ac of jurisdictional wetlands, including small wetlands associated with stream features along London Creek, Little London Creek, and several unnamed tributaries (USACE 2013a).

2.4.2.2 Aquatic Resources – Transmission-Line Corridors

As described in Section 2.2.3.1, Duke proposes to establish two additional offsite transmission-line corridors that would each contain two transmission lines: one 230-kV line and one 525-kV line. Each proposed transmission-line corridor from the Lee Nuclear Station site switchyard has a 325-ft-wide corridor to the first tie-in location on the Pacolet-Catawba transmission line. Each corridor from the Pacolet-Catawba line to the Oconee-Newport tie-in location would have a 200-ft-wide corridor. Both routes would be located in Cherokee and Union Counties, and both routes would cross Thicketty Creek and the Pacolet River (Duke 2009c). Approximately 15.1 mi of corridors would be 325-ft wide, and approximately 16 mi of corridors would be 200-ft wide. There are 46 stream crossings (extending 14,596 linear ft) within the Route K (western) offsite transmission-line ROW and 70 stream crossings (extending 25,530 linear ft) and a 4.06-ac open-water impoundment within the Route O (eastern) offsite transmission-line ROW (USACE 2013a).

Habitat along the proposed transmission-line corridors was surveyed specifically for the Carolina heelsplitter (*Lasmigona decorata*), which is a Federally and State-listed endangered and State-ranked S1 (critically imperiled) aquatic mussel species known to occur in York and Chester Counties (Duke 2009g). The Carolina heelsplitter was not found within streams that will be crossed by the transmission lines. No other Federally or State-protected aquatic species were found during the survey effort.

2.4.2.3 Important Aquatic Species

The NRC has defined important species as species that are rare, ecologically sensitive, play an ecological role, are relied on by a valuable species, and/or have commercial or recreational value (NUREG-1555 [NRC 2000a]). The FWS identifies Federally threatened or endangered species in 50 CFR 17.11 and 50 CFR 17.12. Important species also include those proposed or candidates for listing as Federally threatened or endangered and those ranked as critically imperiled, imperiled, or vulnerable by the State of South Carolina, some of which may also be designated as threatened or endangered by the State. Biological indicator species that respond to and indicate environmental change also are classed as important species.

The following section includes commercially important species, recreationally important species, invasive species, important species, protected species, and State-ranked species that have been documented at the Lee Nuclear Station site, or are thought to occur in the vicinity of the site or counties where proposed transmission-line corridors will be located. The *Comprehensive Wildlife Conservation Strategy* developed by the SCDNR identifies conservation priority species (SCDNR 2005), some of which are known to occur at the Lee Nuclear Station site and vicinity.

Commercially Important Species

There are no commercially important fisheries associated with the portion of the Broad River near the Lee Nuclear Station site.

Recreationally Important Species

Recreational fishers pursue Bluegill, Redbreast Sunfish, Redear Sunfish, Largemouth Bass, Black Crappie, White Catfish, Channel Catfish (*Ictalurus punctatus*), and suckers in Ninety-Nine Islands Reservoir (Duke 2009c). The Broad River also supports a Smallmouth Bass fishery that began with the SCDNR's introduction of the species to the Broad River in 1984 (Bettinger et al. 2003).

Bluegill (*Lepomis macrochirus*)

Native Bluegill are found in pools and backwater areas of low-to-moderate gradient creeks, streams, and rivers (Jenkins and Burkhead 1993). Bluegill inhabit clear and turbid waters with both hard and silted substrates. These fish are generally a prolific species and are popular for sport fishing. Because of their small mouths, the young and juveniles are planktivores and adults generally eat small aquatic and terrestrial insects. Spawning may occur during most of the growing season. Males will construct nests in shallows on sand or gravel, frequently as part of a colony. Females will spawn multiple times during the season and have been reported to produce approximately 80,000 eggs per year. The adhesive eggs are laid in a nest where they cling to the substrate. Larvae are guarded by the male on the nest for several days after hatching. Larger larvae may become limnetic (Duke 2008a).

Bluegill were captured in the vicinity of the Lee Nuclear Station site during all four documented fish surveys (Duke 2009c). In 2006, large numbers of Bluegill were captured at all five sampling stations during each sampling event throughout the year (Duke 2009c).

Redbreast Sunfish (*Lepomis auritus*)

Native Redbreast Sunfish are found in pools and backwaters of warm creeks, streams, and rivers of low-to-moderate gradient, as well as ponds and reservoirs (Jenkins and Burkhead 1993). They most often are found in clear water, but will sometimes inhabit turbid waters. This fish has a high thermal tolerance, having been found in elevated water temperatures (to 102°F) below a power plant outfall in Virginia (Jenkins and Burkhead 1993). These fish are generalists, eating mostly aquatic insects; however, they also prey on crayfish, other arthropods, mollusks, and occasionally fish. Redbreast Sunfish usually breed in waters that are 61 to 82°F, with peak spawning observed within the 68 to 82°F range. Males construct nests over silt-free or lightly silted sand and gravel, often in association with cover. The nests are usually spaced closely in calm, shallow water (less than 3.3 ft deep), though some have been found in the lee of large rocks near swift currents. Females contain approximately 1000 to 8000 ova, with older fish producing larger numbers of eggs. The adhesive eggs are laid in a nest where they cling to the substrate. Larvae are guarded by the male on the nest for several days after hatching. Larger larvae may become limnetic (Duke 2008a).

Redbreast Sunfish were captured in the vicinity of the Lee Nuclear Station site during all four documented fish surveys (Duke 2009c). In 2006, this species was captured in very low numbers at three of five sampling stations during each sampling event throughout the year (Duke 2009c). The greatest numbers were captured below Ninety-Nine Islands Dam. No Redbreast Sunfish were captured in the backwater arms of Ninety-Nine Islands Reservoir (Duke 2009c).

Redear Sunfish (*Lepomis microlophus*)

Native Redear Sunfish are found more often in clear lakes and ponds than in streams or rivers, although the species may also be found in backwater areas of streams and rivers exhibiting lacustrine characteristics (Jenkins and Burkhead 1993). Some tolerance to turbidity has been noted by researchers. Redear Sunfish have large teeth suitable for crushing snails and small mussels for consumption. They also eat aquatic insects and the occasional fish. Spawning generally begins when the water approaches 68 to 70°F and ends by mid-summer or early fall. Nests are built in colonies near vegetation and in shallow (less than 6.6 ft deep) water. Females may produce approximately 15,000 to 30,000 adhesive eggs that cling to the substrate. Larvae are guarded by the male on the nest for several days after hatching. Larger larvae may become limnetic (Duke 2008a).

Redear Sunfish were captured in the vicinity of the Lee Nuclear Station during three of four documented fish surveys (Duke 2009c). In 1973 and 1974, this species was not recorded as being present in the vicinity of the site. In 2006, this species was captured in very low numbers at all five sampling stations during nearly every sampling event throughout the year (Duke 2009c).

Largemouth Bass (*Micropterus salmoides*)

Largemouth Bass are an important game fish and the most widespread of the *Micropterus* genus (Jenkins and Burkhead 1993). Largemouth Bass are stocked in many parts of the United States to provide sport fishing opportunities. These fish inhabit many waters including marshes, ponds, lakes, reservoirs, and small streams to large rivers. In general, they prefer warm, clear water. Juvenile bass eat plankton, small insects, and fish; adults generally feed on larger insects, fish, and crayfish. Spawning occurs in spring when the water reaches temperatures in the 61 to 64°F range, and has been reported to continue until the water reaches 75°F. Several distinct spawning peaks may occur during the season. Males create a nest on a variety of substrates in backwater areas, pools in streams, or along the shores of ponds and reservoirs in water that is usually 1 to 2 ft deep, although nest sites have been documented as deep as 27 ft. These nests may be in the open or associated with aquatic macrophytes or other structure. Adult females average approximately 20,000 ova. After the eggs hatch, the males typically guard their young on the nest for 4 to 8 days (Duke 2008a).

Largemouth Bass were captured in the vicinity of the Lee Nuclear Station site during all four documented fish surveys (Duke 2009c). In 2006, small numbers of this species were captured at all five sampling stations during nearly every sampling event throughout the year (Duke 2009c).

Smallmouth Bass (*Micropterus dolomieu*)

Smallmouth Bass were introduced to the Broad River in 1984, making it a unique fishery in the Piedmont region of South Carolina (Bettinger et al. 2003). These fish live in both cool and warm waters, but generally prefer clear, large lakes, streams, or rivers with gravelly and rocky substrates (Jenkins and Burkhead 1993). Juvenile Smallmouth Bass feed on microcrustaceans, insects, and small fish; adults primarily consume crayfish and fish. Spawning has been observed at water temperatures between 61 and 72°F. Males construct nests in streams near shorelines in 1- to 2-ft-deep water on firm bottoms in slow currents, often adjacent to structure. Estimated numbers of mature ova in adult females range from approximately 2500 to 28,000. The males guard the nests until after the eggs hatch.

Smallmouth Bass have been captured in the vicinity of the Lee Nuclear Station site during three documented fish surveys between 1987 and 2006 (Duke 2009c). In 2006, small numbers of this species were captured by Duke personnel below Ninety-Nine Islands Dam and also at a sampling station located just upstream from the proposed cooling-water intake (Duke 2009c). Between 2000 and 2002, the SCDNR found Smallmouth Bass in at least nine Broad River sampling locations between Parr Shoals and Gaston Shoals (Bettinger et al. 2003). There is evidence that the population is reproducing naturally in some parts of the river, including the area between Ninety-Nine Islands Dam and Cherokee Falls Dam (Bettinger et al. 2003).

Black Crappie (*Pomoxis nigromaculatus*)

Native Black Crappie can live in swamps, ponds, lakes, reservoirs, and slack water areas of low-to-moderate gradient creeks to rivers (Jenkins and Burkhead 1993). These fish are often associated with structures, such as aquatic vegetation, logs, or fallen trees. The young fish prey on microcrustaceans, insects, and larval fish. Adults are largely piscivorous, but will eat a variety of aquatic organisms and terrestrial insects. Black Crappie are early spawners, actively congregating and constructing nests when water temperatures are between 59 and 68°F. Nests are built in shallow-to-moderately deep water (to 20 ft), are often associated with vegetation, and may be crowded. Females can bear 11,000 to 188,000 small eggs, making them a highly fecund species. Eggs adhere to the nest or surrounding objects; after hatching, the larvae remain in the nest for 2 to 4 days before moving to open water (Duke 2008a).

Black Crappie were captured in the vicinity of the Lee Nuclear Station site during all four documented fish surveys (Duke 2009c). In 2006, small numbers of this species were captured at four of the five sampling stations, but observations at each station were sporadic throughout the year (Duke 2009c). No Black Crappie were collected at the sampling station located just upstream from the proposed location for the Lee Nuclear Station's cooling-water-intake structure.

White Catfish (*Ameiurus catus*)

Native White Catfish live mainly in the warm waters of ponds, reservoirs, and medium-to-large rivers (Jenkins and Burkhead 1993). Juveniles typically eat aquatic insects; adults consume a variety of aquatic invertebrates, fish, and plants. The minimum spawning temperature for White Catfish is reported to be 70°F. Both males and females prepare the nest, which is typically in 1- to 1.6-ft-deep water, and guard and fan the nest, which may contain approximately 1500 to 3000 eggs.

White Catfish were captured in the vicinity of the Lee Nuclear Station site during all four documented fish surveys (Duke 2009c). In 2006, small numbers of this species were captured at three of the five sampling stations. Most of the fish were found in one of the two backwater arms of Ninety-Nine Islands Reservoir, but observations at each station were sporadic throughout the year (Duke 2009c). Only two White Catfish were captured at the sampling station located just upstream from the proposed location for the Lee Nuclear Station cooling-water-intake structure. This species has the potential to be negatively affected as a result of predation and competition with exotic catfish species, such as Blue Catfish (*Ictalurus furcatus*) and Flathead Catfish (*Pylodictis olivaris*) (SCDNR 2005).

Channel Catfish (*Ictalurus punctatus*)

Channel Catfish are an introduced species that inhabit both clear and turbid large warm streams, big rivers, ponds, lakes, and reservoirs (Jenkins and Burkhead 1993). In lotic systems, this species is typically associated with pools, but can be found in moderate current. Channel Catfish are considered a prized game fish. Very young catfish eat plankton and insect larvae; juveniles and adults eat a wide variety of aquatic invertebrates, vertebrates (including other fish), and plants. Spawning occurs at water temperatures between 70 and 86°F. Both males and females may construct the nest, but males care for the eggs. Females may produce approximately 4000 to 10,000 eggs per year. The larvae are typically guarded by the male for up to a week after hatching.

Channel Catfish were captured in the vicinity of the Lee Nuclear Station site during three of four documented fish surveys (Duke 2009c). No Channel Catfish were recorded in 1973 or 1974. In 2006, very low numbers were captured at all five sampling stations. None were captured in February 2006, and 12 were captured sporadically, mainly as singles or pairs, throughout the remainder of the year (Duke 2009c).

Sucker Species

Suckers, which are native to the Broad River, are strongly adapted for bottom feeding with mouths that angle downward (Jenkins and Burkhead 1993). Although some anglers target suckers directly, the juvenile fish are often used by anglers as bait. Suckers belong to the family Catostomidae and generally move to shallower, fast-moving water to spawn in early spring. The eggs are deposited in gravel and afforded no protection by the adults. Larval catostomids may swim out of the gravel and enter flowing water where high mortality may occur as they become part of the plankton.

Catostomids captured during all four sampling periods associated with the Lee Nuclear Station site (i.e., 1973 to 1974, 1987, 2000 to 2002, and 2006) include Quillback, White Sucker (*Catostomus commersonii*), Northern Hogsucker (*Hypentelium nigricans*), Notchlip Redhorse, and Striped Jumprock (*Moxostoma rupiscartes*) (Duke 2009c). In addition to these sucker species, the FWS indicated in its letter to Duke (dated May 23, 2006) that a rare, but extant, population of Robust Redhorse (*M. robustum*) was found in the Broad River downstream of the Lee Nuclear Station site (Duke 2010f).

A total of 312 Quillback were captured during Duke's fish surveys in 2006. One fish was taken by electrofishing in October from one of the two backwater arms of the Ninety-Nine Islands Reservoir and 262 were captured in the Ninety-Nine Islands Reservoir during four gillnetting sampling trips conducted in February, April, July, and October 2006 (Duke 2009b; Barwick et al. 2006). Another 49 Quillback were captured by electrofishing downstream of Cherokee Falls in April 2006 (Barwick et al. 2006). The SCDNR captured several Quillback above and below the

Ninety-Nine Islands Dam during its survey of the Broad River between 2000 and 2002 (Bettinger et al. 2003). This species is on the State's Priority Conservation Species List in the high conservation category (SCDNR 2005).

White Suckers, which are often used for bait by fishers, have very generalized habitat requirements (Jenkins and Burkhead 1993). Most of their native range is north and west of South Carolina. Very few were found by the SCDNR during its 2000 to 2002 surveys, but at least one was taken just below Ninety-Nine Islands Dam (Bettinger et al. 2003). In 2006, only two White Suckers were captured by Duke. Both fish were captured in February from the Broad River just below Ninety-Nine Islands Dam (Duke 2009c).

Northern Hogsuckers are not considered game fish; they are associated primarily with lotic systems and prefer hard substrates (Jenkins and Burkhead 1993). Though present in South Carolina, most of their native range is northward. Northern Hogsuckers are sometimes migratory, ascending streams to reproduce, but may spawn where it resides. Their spawning habitat is reported to be the gravelly tails of pools or in medium gravel in shallow moving water (0.3 to 1.5 ft deep).

SCDNR found small numbers of Northern Hogsuckers throughout the Broad River (Bettinger et al. 2003). During the surveys conducted by Duke in 2006 in the Ninety-Nine Islands Reservoir and Broad River, 152 Northern Hogsuckers were captured (Duke 2009c). Higher numbers were observed in July and October than during February and April. A separate survey conducted in April 2006 to target rare catostomid species just below Cherokee Falls Dam in the free-flowing section of the river located five additional Northern Hogsuckers (Barwick et al. 2006).

Notchlip Redhorse are considered a moderate priority species by South Carolina (SCDNR 2005). In 2006, Notchlip Redhorse were observed in very low numbers from all five of Duke's sampling stations. Half of the fish were observed below Ninety-Nine Islands Dam (Duke 2009c). The SCDNR did not capture any of this species during its 2000 to 2002 surveys (Bettinger et al. 2003).

Jumprocks (*Moxostoma* spp.) are generally small and inhabit fast water (Jenkins and Burkhead 1993). In 2006, moderate numbers of Striped Jumprocks and Brassy Jumprocks were captured by Duke below Ninety-Nine Islands Dam throughout the year (Duke 2009c). One Brassy Jumprock specimen was captured during February in the main channel of Ninety-Nine Islands Reservoir, just above the proposed location for the Lee Nuclear Station cooling-water-intake structure. The targeted catostomid electrofishing surveys conducted just downstream of Cherokee Falls Dam in April 2006 located 39 Brassy Jumprocks (Barwick et al. 2006). The SCDNR also captured small numbers of Striped and Brassy Jumprocks above and below Ninety-Nine Islands Dam (Bettinger et al. 2003).

Robust Redhorse are large suckers that can reach lengths over 17 in. (SCDNR 2005). They have large teeth specialized for crushing their food, which includes native mussels. Robust Redhorse have no legal conservation status in South Carolina, but are on the State's priority conservation list in the highest conservation category (SCDNR 2005). In South Carolina, wild populations of Robust Redhorse are known to exist in the Savannah and Pee Dee Rivers. The SCDNR has also been stocking the Broad River with Robust Redhorse every year since 2004, with over 50,000 fingerlings released to date. In 2006 the FWS stated that Robust Redhorse were found in the Broad River downstream of Ninety-Nine Islands Dam (FWS 2006). Over 15,000 Robust Redhorse have been introduced to the Wateree River since 2005 (Georgia Power 2011). It is unclear whether the introduced populations will be able to sustain themselves over time (Georgia Power 2011).

Nuisance Species

No invasive aquatic plant species have been noted in the Broad River aquatic environment near the proposed Lee Nuclear Station. However, one nuisance fish species, the Smallmouth Buffalo (*Ictiobus bubalus*), and the invasive Asiatic clam have been observed (Duke 2009c).

<u>Smallmouth Buffalo (*Ictiobus bubalus*)</u>

Smallmouth Buffalo are an introduced fish species. The method of its introduction to North Carolina and South Carolina is unknown (Fuller 2009). This species was collected by the SCDNR near the site in 2001 (Bettinger et al. 2003), but was previously undocumented in the Broad River (Duke 2009c). The impact of Smallmouth Buffalo on other Broad River species is unknown (Fuller 2009); however, they may compete with some of the local redhorse fish species (SCDNR 2005).

<u>Asiatic Clam (*Corbicula fluminea*)</u>

Asiatic clams are a nonindigenous species of mussel introduced on the West Coast of the United States in the 1930s that migrated east to South Carolina by the 1970s. Asiatic clams are generally considered a nuisance species because of their ability to reproduce rapidly and because of their tendency to foul raw water-intake pipes at power and water-supply facilities (Foster et al. 2012). Unlike most native mussels, Asiatic clams do not require a fish host during their larval period. In addition, Asiatic clams are highly resistant to desiccation and may be better adapted than most native species to survive dry periods (Bogan and Alderman 2008). Asiatic clams are often found in sandy substrate in slow-flowing rivers and are present throughout the Broad River basin (Duke 2009c; Bogan and Alderman 2008). Asiatic clams were found in Make-Up Pond B in 2006 (Duke 2009c).

Diadromous Fish Species Potentially Available in Future

Although fish-passage facilities are unlikely to be located at Ninety-Nine Islands Dam before 2020, if the COLs are granted and the new units constructed, a fishway could be installed during the operational period of the Lee Nuclear Station. Therefore, while the fish species identified below are not currently found in the vicinity of the Lee Nuclear Station site, plans to provide fish-passage at dams on the Broad River could lead to their presence in the site vicinity in the future. Diadromous species addressed in the *Santee River Basin Accord for Diadromous Fish Protection*, *Restoration*, *and Enhancement* include the American Eel (*Anguilla rostrata*), American Shad, Blueback Herring, Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*), and Shortnose Sturgeon (*A. brevirostrum*) (SRBA 2008). American Eel and American Shad, which are the only species with historical presence in the vicinity of the Lee Nuclear Station site, are discussed below (FWS 2001). The NRC staff's correspondence to NMFS regarding diadromous fish species is listed in Appendix F.

American Eel (*Anguilla rostrata*)

American Eel are catadromous (i.e., they spawn in the ocean, but otherwise inhabit fresh, brackish, or estuarine water). South Carolina has placed the American Eel in the highest priority category on its Priority Conservation Species List (SCDNR 2005), but the species has no legal protection status. The following description is based on a species description prepared by the SCDNR (SCDNR 2005). In South Carolina, historical records indicate the fish were present in the Santee River Basin, well inland of the fall line and into North Carolina. Juvenile eels, called elvers, may migrate far into inland habitats. Small eels can climb wet, textured vertical walls, but are unable to scale large structures such as the existing dams on the Broad River. When juvenile eels exceed 4 in. in length, they are called yellow eels. Primarily during spring and fall, yellow eels may migrate upstream, gradually migrating farther and farther inland over the years. The fish mature between 3 and 24 years, with females growing larger, living longer, and migrating much farther inland than males, which generally are restricted to estuarine and brackish water habitats. American eels can be found in all habitats with sufficient food resources and well-oxygenated water.

American Shad (*Alosa sapidissima*)

The American Shad are anadromous and spawn in large river basins. Although South Carolina has placed the American Shad in the highest priority category on its Priority Conservation Species List (SCDNR 2005), the species has no legal protection status. The following description is based on a species description prepared by the SCDNR (SCDNR 2005). Historic data show American Shad once ascended the Santee River Basin, well inland of the fall line and into North Carolina. Upstream migration and spawning is temperature-dependent, but generally occurs between mid-January and mid-May in South Carolina. Peak spawning occurs during March and April. American Shad release groups of eggs in batches as they move upstream. These eggs are semi-buoyant and can drift in the water column. Juveniles may spend a year or more maturing in freshwater before reaching the ocean.

Although populations are probably depressed from levels predating dams, American Shad have responded well to existing fish-passage protocols and increased flows at hydropower projects. In fact, the American Shad population in the Santee-Cooper River Basin is currently among the largest on the Atlantic coast.

Threatened and Endangered Aquatic Species

State-Ranked Species

As described in Section 2.4, the State ranking provides the only common basis for comparison of numbers of important animal and plant species at the Lee Nuclear Station site located in South Carolina, the Keowee and Middleton Shoals alternative sites (also located in South Carolina), and the Perkins alternative site in North Carolina (see Chapter 9.3, Alternative Sites). This section describes the Carolina Fantail Darter, a South Carolina State-ranked aquatic species known to occur near the Lee Nuclear Station site (Table 2-13), and the Carolina Darter (*Etheostoma collis*). Although not State-ranked, the Carolina Darters are assigned a State-protection status of threatened. Carolina Darter occur in York County (SCDNR 2012f), but not within 15 mi of the Lee Nuclear Station (SCDNR 2012a).

Table 2-13. Federally Listed and State-Ranked Aquatic Species that May Occur in the Vicinity of the Lee Nuclear Station Site or Transmission-Line Corridors

Scientific Name	Common Name	Federal Status[(a)]	State Status/ Rank[(b)]
Fish			
Etheostoma brevispinum	Carolina Fantail Darter	-	-/S1
Etheostoma collis	Carolina Darter	-	SNR/T
Mussels[(c)]			

(a) Federal status rankings determined by the FWS under the Endangered Species Act of 1973 (FWS 2012a).
(b) State rank: S1 = critically imperiled, SNR = not ranked; State status: T = threatened (SCDNR 2012a).
(c) The Carolina heelsplitter (*Lasmigona decorata*) is listed by the FWS as endangered in York County, South Carolina (FWS 2012a), but occurs only within the Catawba River drainage (SCDNR 2005).

Carolina Fantail Darter (*Etheostoma brevispinum*). Formerly known as the Fantail Darter (*Etheostoma flabellare*), the *E. flabellare brevispinum* subspecies was elevated to species level and is now known as *E. brevispinum* (Blanton and Schuster 2008). The Carolina Fantail Darter is ranked in South Carolina as an “S1” species (i.e., critically imperiled statewide because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation) (SCDNR 2012a). South Carolina has placed this species in the high priority category on its Priority Conservation Species List (SCDNR 2005). The Carolina form of the Fantail Darter is endemic to the Piedmont and Blue Ridge sections of the Upper Pee Dee and Santee River drainages in the State (SCDNR 2005). These fish inhabit gravel riffles in small-to-medium-sized rivers in strong currents and rely on rocky substrates for feeding and spawning. The geographic isolation of the Carolina Fantail Darter makes the species vulnerable to pollution, development, and habitat alterations. Carolina Fantail Darter are considered secure in North Carolina, but relatively little is known of their population size or trends in South Carolina (SCDNR 2005). The global conservation status rank for the species is G4, apparently secure (NatureServe Explorer 2013).

Carolina Fantail Darter spawn in water between 59 and 75°F (Jenkins and Burkhead 1993). Their spawning habitat includes runs and slow riffles where the fish lay adhesive eggs on the underside of stones. The females may spawn approximately five times per year, with single egg counts reported to range between approximately 50 and 550 (Jenkins and Burkhead 1993).

Duke captured Carolina Fantail Darter during all four surveys conducted in the vicinity of the site (Duke 2009c). In 2006, one specimen was captured just upstream from the proposed location for the Lee Nuclear Station cooling-water intake (Duke 2009c). A total of 51 specimens were collected in 2003 and 2004 from four Broad River tributary sites, including Kings Creek, which joins the Broad River immediately below Ninety-Nine Islands Dam (Bettinger et al. 2006).

Carolina Darter (*Etheostoma collis*). Carolina Darter have a South Carolina State-protection status of threatened and are designated as a species of high conservation priority by the SCDNR (SCDNR 2005). This species is not ranked in South Carolina, but does have a global conservation status rank of G3, vulnerable (NatureServe Explorer 2013). These small (up to 6-cm long) fish are typically found in small upland creeks and rivulets in both wooded and pasture areas in pools or slow-moving runs and often among vegetation that includes brush and fallen tree limbs (NatureServe Explorer 2010). They are difficult to sample in such habitat. Carolina Darter exist only in the Piedmont region from south-central Virginia through North Carolina and into north-central South Carolina (SCDNR 2005). However, watershed distribution maps indicate the species are likely extirpated in the Broad River drainage (NatureServe Explorer 2010). No Carolina Darter have been sampled by Duke or the SCDNR in the vicinity of the Lee Nuclear Station site (Bettinger et al. 2006; Duke 2009b).

Federally Listed Species

In a letter dated April 9, 2008, the NRC requested that the FWS Field Office in Atlanta, Georgia, provide information regarding Federally listed, proposed, and candidate species and critical habitat that may occur in the vicinity of the Lee Nuclear Station site (NRC 2008e). On May 13, 2008, the FWS provided a response letter that included a list of Federally listed species in Cherokee, Union, and York Counties (FWS 2008a), which encompass the Lee Nuclear Station site, the Make-Up Pond C site, the railroad-spur corridor, the two proposed transmission-line corridors, and the six offsite road-improvement areas. The FWS indicated that one listed mussel species, the Carolina heelsplitter, was known to be present in York County (Table 2-13). However, the review team reviewed the literature and species summaries for these areas and found no evidence that any Federally listed aquatic species is likely to be found in the vicinity of the Lee Nuclear Station site (FWS 2010c). The NRC staff's correspondence to the FWS regarding Federally protected species is listed in Appendix F.

Carolina heelsplitter (*Lasmigona decorata*). Carolina heelsplitter is a Federally endangered aquatic species that may reside in rivers, creeks, or streams (FWS 2010c, d). South Carolina lists it as an endangered species, ranks it S1 (i.e., critically imperiled statewide because of extreme rarity or because of some risk factor(s) making it especially vulnerable to extirpation), and classifies it as a species of highest conservation priority (SCDNR 2012a). The global conservation status rank for the Carolina heelsplitter is G1, critically imperiled (NatureServe Explorer 2013). It is listed by the FWS as present in York County, South Carolina, which bounds the Broad River downstream of Ninety-Nine Islands Dam (FWS 2010c). The Carolina heelsplitter has not been located in the Broad River or its tributaries, but does occur within the Catawba River drainage (SCDNR 2005). Critical habitat has been designated only in Chesterfield, Edgefield, Greenwood, Kershaw, Lancaster, and McCormick Counties in South Carolina, none of which are associated with the proposed Lee Nuclear Station preconstruction or construction activities (67 FR 44501).

Additional Species of Ecological Importance

In addition to the species listed by the State as threatened or endangered, or ranked S1 to S3, additional species have been given priority for conservation in South Carolina by the SCDNR (SCDNR 2005). These species are considered ecologically important aquatic species. A list of ecologically important aquatic species associated with the Lee Nuclear Station site and transmission-line corridors is provided in Table 2-14.

Table 2-14. Ecologically Important Aquatic Species

Scientific Name	Common Name	Status
Fish		
Ameiurus brunneus	Snail Bullhead	Biological indicator ("moderate" conservation priority in South Carolina, SNR).[(a)] Captured by the SCDNR in 2000, 2001, and 2002 at all 11 of its Broad River sampling sites, including sites in the vicinity of the Lee Nuclear Station site.[(b)] One specimen was captured by Duke in 2006 near the proposed cooling-water-intake structure location, and 194 were captured just below Ninety-Nine Islands Dam.[(c)] Also found by the SCDNR in 2003 and 2004 in Thicketty Creek, a tributary to the Broad River that would be crossed by new transmission lines associated with Lee Nuclear Station.[(d)]

Table 2-14. (contd)

Scientific Name	Common Name	Status
Ameiurus platycephalus	Flat Bullhead	Biological indicator ("moderate" conservation priority in South Carolina, SNR).[a] Captured by the SCDNR in 2000, 2001, and 2002 at eight sites on the Broad River, including sites in the vicinity of the proposed new nuclear station.[b] Found by Duke in 2006 in one of the two backwater areas, near the proposed intake structure location, and just below Ninety-Nine Islands Dam.[c] Also found by the SCDNR in 2003 and 2004 in Thicketty Creek, a tributary to the Broad River that would be crossed by new transmission lines associated with Lee Nuclear Station.[d] Also captured by the SCDNR in 2010 in London Creek.[e]
Carpiodes velifer	Highfin Carpsucker	Biological indicator ("highest" conservation priority in South Carolina).[a] Possibly captured by the SCDNR in 2002 just below Cherokee Falls Dam and below Ninety-Nine Islands Dam.[b]
Cyprinella chloristia	Greenfin Shiner	Biological indicator ("moderate" conservation priority in South Carolina, S4).[a] Captured by the SCDNR in 2000, 2001, and 2002 at all 11 of its Broad River sampling sites, including sites in the vicinity of the Lee Nuclear Station site.[b] Three specimens were captured by Duke in 2006, below Ninety-Nine Islands Dam.[c] Also found by the SCDNR in 2003 and 2004 in Thicketty Creek, a tributary to the Broad River that would be crossed by new transmission lines associated with the Lee Nuclear Station.[d] Also captured in 2010 by the SCDNR in London Creek.[e]
Cyprinella labrosa	Thicklip Chub	Biological indicator ("moderate" conservation priority in South Carolina, SNR).[a] Captured by the SCDNR in 2000, 2001, and 2002 at all 11 of its Broad River sampling sites, including sites in the vicinity of the Lee Nuclear Station site.[b] Four specimens were captured by Duke in 2006 below Ninety-Nine Islands Dam.[c]
Cyprinella pyrrhomelas	Fieryblack Shiner	Biological indicator ("moderate" conservation priority in South Carolina, S4).[a] Six specimens were captured by Duke in 2006, below Ninety-Nine Islands Dam.[c]
Cyprinella zanema	Santee Chub	Biological indicator ("high" conservation priority in South Carolina, SNR).[a] Reported as captured in the Broad River in the vicinity of Cherokee Nuclear Station between 1974 and 1976.[f] Captured by the SCDNR in 2002, but only at one site on the Broad River between the Lockhart and Neal Shoals Dams.[b]
Etheostoma thalassinum	Seagreen Darter	Biological indicator ("high" conservation priority in South Carolina, SNR).[a] Captured by the SCDNR in 2000, 2001, and 2002 at six sites on the Broad River.[b] Species was never observed between the Cherokee Falls and Lockhart Dams. However, it was found by the SCDNR in 2003 and 2004 in Thicketty Creek, a tributary to the Broad River that would be crossed by new transmission lines associated with the Lee Nuclear Station.[d]
Hybopsis hypsinotus	Highback Chub	Biological indicator ("moderate" conservation priority in South Carolina, SNR).[a] Captured by the SCDNR in 2003 and 2004 in Thicketty Creek, a tributary to the Broad River that would be crossed by new transmission lines associated with the Lee Nuclear Station.[d] Also captured in 2010 by the SCDNR in London Creek.[e]

Table 2-14. (contd)

Scientific Name	Common Name	Status
Moxostoma pappillosum	V-lip Redhorse	Biological indicator ("moderate" conservation priority in South Carolina).[(a)] Captured by the SCDNR in 2001, at six sites on the Broad River, including sites in the vicinity of the Lee Nuclear Station site.[(b)] Two specimens were captured by Duke in 2006, just below Ninety-Nine Islands Dam.[(c)]
Notropis chlorocephalus	Greenhead Shiner	Biological indicator ("high" conservation priority in South Carolina).[(a)] Captured in 2010 by the SCDNR in London Creek.[(e)]
Percina crassa	Piedmont Darter	Biological indicator ("high conservation priority in South Carolina, SNR).[(a)] Captured by the SCDNR in 2000, 2001, and 2002 at 10 sites on the Broad River, including sites in the vicinity of the Lee Nuclear Station site.[(b)] Captured by Duke in 2006 only below Ninety-Nine Islands Dam.[(c)]
Mussels		
Elliptio angustata	Carolina lance	Biological indicator ("moderate" conservation priority in South Carolina).[(a)] A single live specimen was found by Duke in 2006, just below Ninety-Nine Islands Dam.[(c)]
Elliptio complanata complex	Eastern elliptio	Biological indicator ("moderate" conservation priority in South Carolina).[(a)] Found by the SCDNR in 2002, but only above Cherokee Falls Dam and below Parr Shoals Dam.[(b)] A single live specimen was found by Duke in 2006, just below Ninety-Nine Islands Dam.[(c)]

(a) Source: SCDNR 2005
(b) Source: Bettinger et al. 2003
(c) Source: Duke 2009c
(d) Source: Bettinger et al. 2006
(e) Source: SCDNR 2011b
(f) Source: Duke 2008a

2.4.2.4 Aquatic Ecology Monitoring

The NRC does not impose conditions of operation, including monitoring requirements, in the area of water quality. Regulation of water quality is implemented by a National Pollutant Discharge Elimination System (NPDES) permit issued by the EPA or the states (i.e., South Carolina). The NRC's role in water quality is limited to assessing aquatic impacts as part of its National Environmental Policy Act of 1969, as amended (NEPA) evaluation.

On August 15, 2011, Duke submitted its NPDES application to the SCDHEC. SCDHEC issued Duke an NPDES Permit (Permit No. SC0049140) on July 17, 2013, effective September 1, 2013 (SCDHEC 2013a). This permit outlines requirements for monitoring of aquatic ecological resources during operation of the proposed units.

Duke conducted several surveys of the aquatic resources that might be affected by building the proposed new nuclear units and a new supplemental water-supply reservoir. Early monitoring was completed in the 1970s, when Duke Power Company began building Cherokee Nuclear

Station Units 1, 2, and 3 (Duke Power Company 1974a; Duke 2008a; NRC 1975a). Initial sampling was performed between October 1973 and September 1974. Further ecological surveys were performed between September 1974 and December 1976 as a continuation of the initial 1-year baseline study.

As part of its program, Duke Power Company studied the Broad River, Ninety-Nine Islands Reservoir, two onsite creeks that were later impounded to form Make-Up Ponds A and B, respectively, and several tributaries to the Broad River. Biological communities studied included phytoplankton, periphyton, zooplankton, benthos, and fish.

Since the 1970s, phytoplankton, periphyton, and zooplankton populations have not been reassessed. The SCDNR has performed several recent relevant surveys of fish, mussels, and benthic macroinvertebrates in the Broad River basin (Bettinger et al. 2003, 2006; Bulak et al. 2000, 2001). The results of these surveys are included in the description of aquatic biota in Section 2.4.2.1, "Aquatic Communities of the Proposed Site."

In March, April, June, and October 2006, Duke made reconnaissance visits to the site (Duke 2009c). In June 2006, a meeting was held onsite with Duke and representatives from the USACE to tour the property and view wetlands and streams potentially within the USACE's regulatory jurisdiction. Also in 2006, Duke conducted a literature review and field study designed to characterize current populations of fish, macrobenthic biota, and mussels in the vicinity of the Lee Nuclear Station site (Duke 2008a). Standard operating procedures for benthic macroinvertebrates, as published by the North Carolina Department of Environment and Natural Resources, were used, including making seasonal corrections and using the Piedmont Criteria when appropriate (NCDENR 2006).

During March and September of 2008 and 2009, Duke surveyed London Creek for macroinvertebrates and fish (Derwort and Hall 2009; Coughlan 2009). An additional London Creek macroinvertebrate survey was conducted by Duke in a previously unsampled location in June 2009 (Derwort and Hall 2009), and an additional fish survey was completed by the SCDNR in May 2010 (SCDNR 2011b). The farm ponds in the vicinity of Make-Up Pond C also were surveyed by Duke in 2010 (Duke 2010d). No aquatic ecology monitoring is proposed during preconstruction and construction of the proposed Lee Nuclear Station Units 1 and 2 (Duke 2010e). The proposed new units will be designed to meet the Phase I, New Facility requirements in 40 CFR 125.80 to 89, under Track I. The EPA requirements meet the Clean Water Act 316(b) rules to verify there will be minimal increases in fish and benthic community impingement and entrainment for the new cooling-water intake structures. Monitoring required for proposed Units 1 and 2 to comply with Track I include biological monitoring for impingement and entrainment of commercial, recreational, and forage base fish and shellfish species as required by 40 CFR 125.87.

2.5 Socioeconomics

This section describes the socioeconomic baseline of the Lee Nuclear Station site. It describes the characteristics of the region surrounding the proposed site, including population demographics and density, and uses that data to form the basis for assessing the potential social and economic impacts from the building and operation of proposed Lee Nuclear Station Units 1 and 2. Unless otherwise specified, the information presented in this section is based on the Duke ER (Duke 2009c) and has been confirmed by the review team.

These impacts are for the region[(a)] surrounding the proposed site. This discussion emphasizes the socioeconomic characteristics of Cherokee and York Counties, although it considers the entire region within a 50-mi radius of the proposed site. These two counties constitute the economic impact area where the review team expects all noticeable economic impacts (e.g., employment, income effects, tax impacts) would occur. The scope of the socioeconomics review is guided by the magnitude and nature of the expected impacts of construction, maintenance, and operation of the proposed project and by those site-specific community characteristics that can be expected to be affected by these impacts. The review team concluded, after discussions with local officials in counties surrounding the proposed Lee Nuclear Station, that both construction and operations workers are likely to settle in several different counties in the region. However, due to the size of counties such as Spartanburg County, South Carolina and Gaston County, North Carolina, local officials presumed in-migrating construction workers for proposed Lee Nuclear Station Units 1 and 2 would not significantly impact them, and could easily be absorbed by, the community (Niemeyer 2008). Officials from Cleveland County, North Carolina, also stated they have excess capacity within their services, education, and housing to absorb in-migration (NRC and PNNL 2008).

The population data for the region are based on the 2010 U.S. Census Bureau (USCB) American Community Survey (ACS) 5-year data for 2006 through 2010 (USCB 2010a, b, c, d). In addition, the review team analyzed the economic, employment, and population trends for the region using additional USCB data sets and population projections from the North Carolina Office of State Budget and Management and the South Carolina State Budget and Control Board.

(a) For the purposes of the EIS, the relevant region is limited to that area necessary to include social and economic base data for (1) the county in which the proposed plant would be located, and (2) those specific portions of surrounding counties and urbanized areas (generally up to 50 mi from the Lee Nuclear Station site) from which the construction/operations workforce would be principally drawn, or that would receive stresses to community services by a change in the residence of construction/operations workers.

The analytical area is a 50-mi circle centered on the proposed power block and includes all or a portion of 23 counties in South and North Carolina. Table 2-15 identifies the counties and provides some summary geographic and demographic information for each county. Figure 2-19 shows a map of the analytical area.

Table 2-15. Population of Counties Within 50 mi of the Proposed Lee Nuclear Station

County	State	Population (2006–2010 ACS 5-Year Data)	Population Density per mi^2 (2010)
Burke	NC	90,912	179.3
Cabarrus	NC	178,011	492.1
Catawba	NC	154,358	387.1
Cleveland	NC	98,078	211.3
Gaston	NC	206,086	578.8
Henderson	NC	106,740	286.1
Iredell	NC	159,437	277.8
Lincoln	NC	78,265	262.7
McDowell	NC	44,996	102.1
Mecklenburg	NC	919,628	1755.5
Polk	NC	20,510	86.3
Rutherford	NC	67,810	120.2
Union	NC	201,292	318.7
Cherokee	SC	55,342	140.9
Chester	SC	33,140	57.1
Fairfield	SC	23,956	34.9
Greenville	SC	451,225	574.7
Lancaster	SC	76,652	139.6
Laurens	SC	66,537	93.2
Newberry	SC	37,508	59.5
Spartanburg	SC	284,307	351.9
Union	SC	28,961	56.3
York	SC	226,073	332.2

Source: 2006-2010 USCB ACS 5-Year Summary (USCB 2010e)

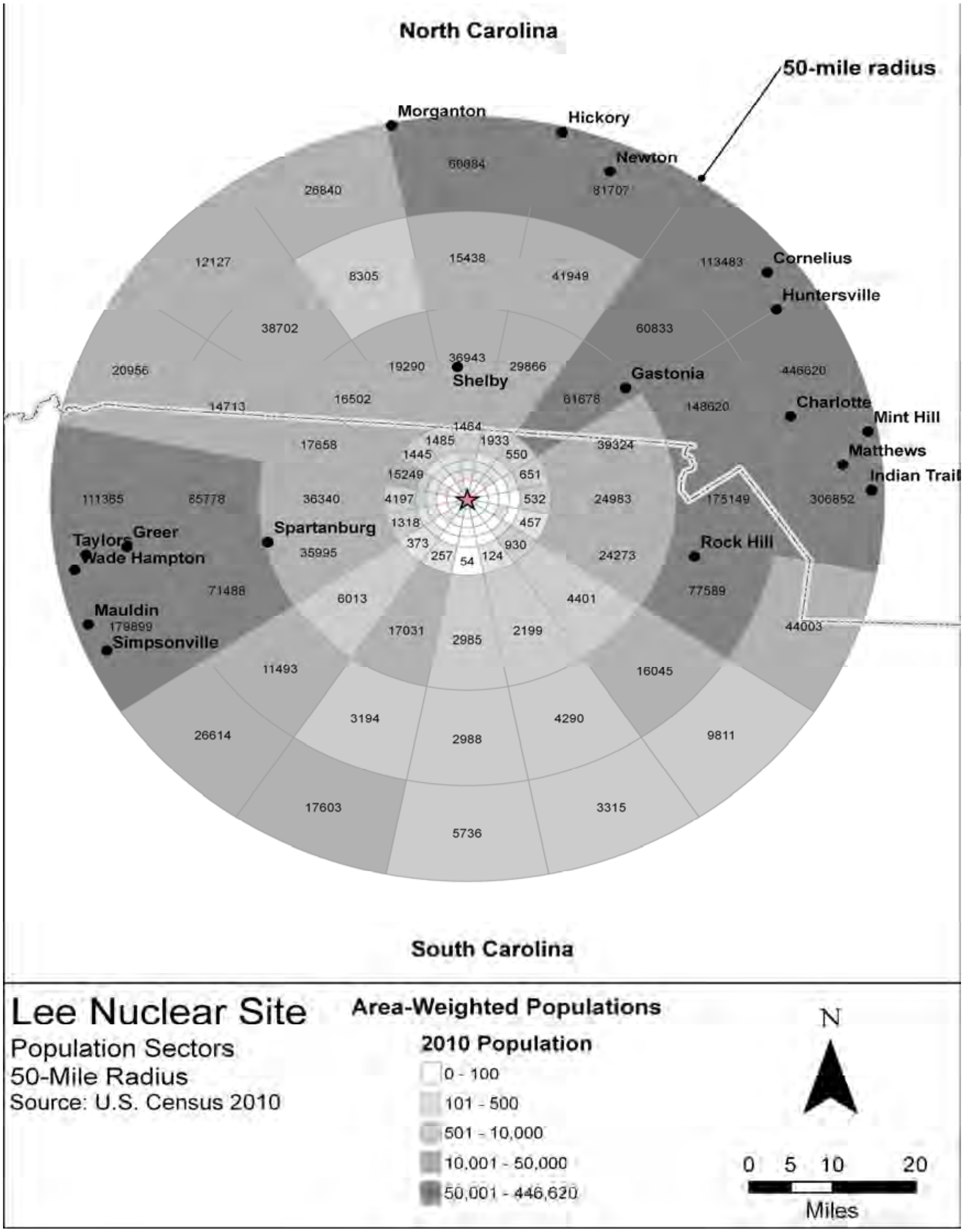

Figure 2-19. Estimated 2010 Population Within 50 mi of the Lee Nuclear Station Site (USCB 2011a)

2.5.1 Demographics

For the purposes of this analysis, the review team divided the total population within the analytical area into three major groups: residents, who live permanently in the area; transients, who may temporarily live in the area but have a permanent residence elsewhere; and migrant workers, who travel into the area to work and then leave after their job is done. Transients and migrant workers are not fully characterized by the U.S. Census, which generally captures only resident populations.

2.5.1.1 Resident Population

Figure 2-19 shows the area-weighted 2010 population estimates derived from county estimates that were based on the cohort-component method within 50 mi of the center point between proposed Lee Nuclear Station Units 1 and 2. The center of the circle in Figure 2-19 is the power block for the proposed Lee Nuclear Station, with concentric circles at 2, 4, 6, 8, 10, 16, 40, 60, and 80 km (1.24, 2.5, 3.7, 5, 6.2, 10, 25, 37, and 50 mi) from the center point between proposed Lee Nuclear Station Units 1 and 2. Population distribution is highest east-northeast and southwest of the Lee Nuclear Station site. Resident population data for the area surrounding the Lee Nuclear Station site indicate low population densities and a rural setting outside the cities and towns.

Based on USCB ACS 2010 Summary data, approximately 40,823 people live within 10 mi of proposed Lee Nuclear Station Units 1 and 2, resulting in a population density of 130 persons/mi^2. The closest residential cities to the proposed site are East Gaffney, South Carolina (7.5 mi northwest) and Blacksburg, South Carolina (5.8 mi north) (Duke 2009c, USCB 2011a). Their population estimates for the year 2009 were 2784 and 2007, respectively (USCB 2010e). The closest residence and business to the proposed Lee Nuclear Station are both on McKowns Mountain Road, approximately 0.99 and 0.80 mi away, respectively (Duke 2009c, 2013d).

The most populated city in the 50-mi region is Charlotte, North Carolina (population 705,896), located 40 mi northeast of proposed Lee Nuclear Station Units 1 and 2. Other large North Carolina cities in the 50-mi region include Gastonia (population 70,709), which is 24 mi northeast and Hickory (population 39,932), which is 49 mi north-northeast. The largest cities in South Carolina in or near the 50-mi region are Rock Hill (population 63,108), which is 29 mi east-southeast; Greenville (population 57,821), which is 52 mi west-southwest; and Spartanburg (population 37,488), which is 25 mi west-southwest (USCB 2010e). These towns provide shopping and services to the local region.

Table 2-16 describes population information for Cherokee and York Counties and South Carolina from 1970 through 2010. The table also provides estimated population projections through 2035 based on estimates developed by the South Carolina's Office of Research & Statistics. Although the review team has updated its demographic data to more recent information, the projections in Table 2-16 display future projections of population from the

South Carolina Budget and Control Board (SCBCB), which performs its own independent estimates. These estimates provide the basis for a number of analyses in this EIS that evaluate future impacts. The review team determined that the estimates in Table 2-16 are consistent with the demographic data in the 2006-2010 ACS 5-Year Summary data. Therefore, the data in Table 2-16 are still valid and no update is required for the purposes of this EIS. Data in Table 2-16 indicate that Cherokee and York Counties have been growing and are projected to continue growing for the foreseeable future.

Table 2-16. Population Growth in Cherokee and York Counties

	Cherokee County	York County	South Carolina
1970	36,669	85,216	2,590,516
1980	40,983	106,720	3,122,814
1990	44,506	131,497	3,486,703
2000	52,537	164,614	4,012,012
2005	53,545	189,398	4,254,989
2010	55,800	218,990	4,549,150
Projections			
2015	58,780	235,930	4,784,700
2020	61,760	252,860	5,020,400
2025	64,760	269,790	5,256,080
2030	67,350	287,970	5,488,460
2035	70,170	305,440	5,722,720

Source: SCBCB 2006a, b and SCBCB 2010

2.5.1.2 Transient Population

Transients include people who work in or visit large workplaces, schools, hospitals and nursing homes, correctional facilities, hotels and motels, and at recreational areas or special events where there may be seasonal and workday variations in population. The 50-mi region includes a number of facilities, venues, and recreational areas that attract transient populations in substantial numbers. Outdoor recreation opportunities in the 50-mi region include a number of parks and water-based and forest-based recreational opportunities. These locations provide a range of activities, including fishing, camping, biking, picnicking, and hiking.

Shopping and natural attractions in the area attract thousands of visitors each year. Most of the transient population near the Lee Nuclear Station site is attributed to shoppers at the Gaffney Premium Outlets in Gaffney, South Carolina. Gaffney Premium Outlets has an average of 7671 visitors a day, for a total of 2.8 million visitors per year. Natural attractions are the second largest transient population contributor within the 50-mi region of the Lee Nuclear Station. The closest park is Kings Mountain State Park (7.8 mi northeast), which averages 548 daily visitors. Kings Mountain State Park is adjoined at its northwest border with Kings Mountain National

Military Park (12 mi northwest), which averages 1452 daily visitors and Cowpens National Battlefield (18 mi northwest), which averages 573 daily visitors. A portion of Francis Marion and Sumter National Forests are within the Lee Nuclear Station 50-mi region and accounts for approximately 3000 daily visitors. Other attractions include Christmastown, USA, with over 600,000 visitors per year and the City of Charlotte, North Carolina, where visitors travel for vacation and business purposes. Table 2-17 lists the major contributors to the transient population and Figure 2-20 shows their location relative to the Lee Nuclear Station site (Duke 2009c).

2.5.1.3 Migrant Labor

The USCB defines a migrant laborer as someone who is working seasonally or temporarily and moves one or more times from one place to another for seasonal or temporary employment. The 2007 Census of Agriculture indicates the migrant population within 50 mi of the proposed Lee Nuclear Station is low.[(a)] As a part of the census, farm operators were asked whether any hired or contract workers were migrant workers, defined as a farm worker whose employment required travel that prevented the worker from returning to a permanent residence the same day. Migrant laborers tend to work short-duration (usually less than 150 days), labor-intensive jobs harvesting fruits and vegetables. Only 8 of 416 total farms in Cherokee County and 13 of 1036 farms in York County employ migrant workers (USDA 2009a).

2.5.2 Community Characteristics

The Lee Nuclear Station site is in a quiet, rural area with two small cities located within 16 km (10 mi) of the site. The Lee Nuclear Station site is located in an unincorporated part of Cherokee County. As stated earlier, most impacts are expected to occur within Cherokee and York Counties. The review team realizes some workers may choose to live outside of Cherokee and York Counties. However, the review team expects any impacts occurring outside of these two counties would be negligible due to the large population of those outside counties relative to the size of the workforce.

Approximately 25 percent of the population in the 50-mi region around the Lee Nuclear Station site is minority, primarily black. In 2010, approximately 14 percent of the households in counties within the region had incomes below the poverty level (USCB 2010e). In 2000, Cherokee and York Counties had 13.9 and 10 percent of individuals living under the poverty level, respectively (USCB 2000a, b). However, 2006-2010 ACS estimates indicated that the number of individuals living below the poverty level in Cherokee and York Counties has increased to 19.5 and 12.5 percent, respectively (USCB 2010e). Racial characteristics and income levels for Cherokee and York Counties are described in Table 2-18.

(a) During the preparation of this final EIS, the latest U.S. Department of Agriculture Census of Agriculture was still the 2007 study referenced in the draft EIS.

Table 2-17. Major Contributors to Transient Population

Name	Average Daily Transients[(a)]	Peak Daily
Christmastown USA	23,077	
Charlotte Knights Baseball Club		10,000
Gaffney Premium Outlets	7671	
Sumter National Forest	7268	
Daniel Stowe Botanical Garden	6000	
South Carolina Peach Festival		2500
Christmas on Limestone		2000
Kings Mountain National Military Park	1452	
Spartanburg Museum of Art	1000	
Crowders Mountain State Park	930	
Mint Museum of Art	750	
Chimney Rock Park	684	
Cowpens National Battlefield	573	
Kings Mountain State Park	548	
South Mountain State Park	527	
Roper Mountain Science Center	515	
Schiele Museum of Natural History	500	
Hollywild Animal Park	411	
Croft State Natural Area	345	
Hatcher Garden and Woodland Preserve	305	
Charlotte Museum of History	113	
Landsford Canal State Park	82	
Chester State Park	64	
Paris Mountain State Park	52	
Charlotte Steeplechase	41	
Gaffney Visitor's Center	35	
Musgrove Mill State Historic Site	28	
Spartanburg County Historical Museum	15	
Rose Hill Plantation State Historic Site	15	

Source: Duke 2009c

(a) Daily transients are peak numbers, when available. Otherwise, a daily average derived from the annual total is used.

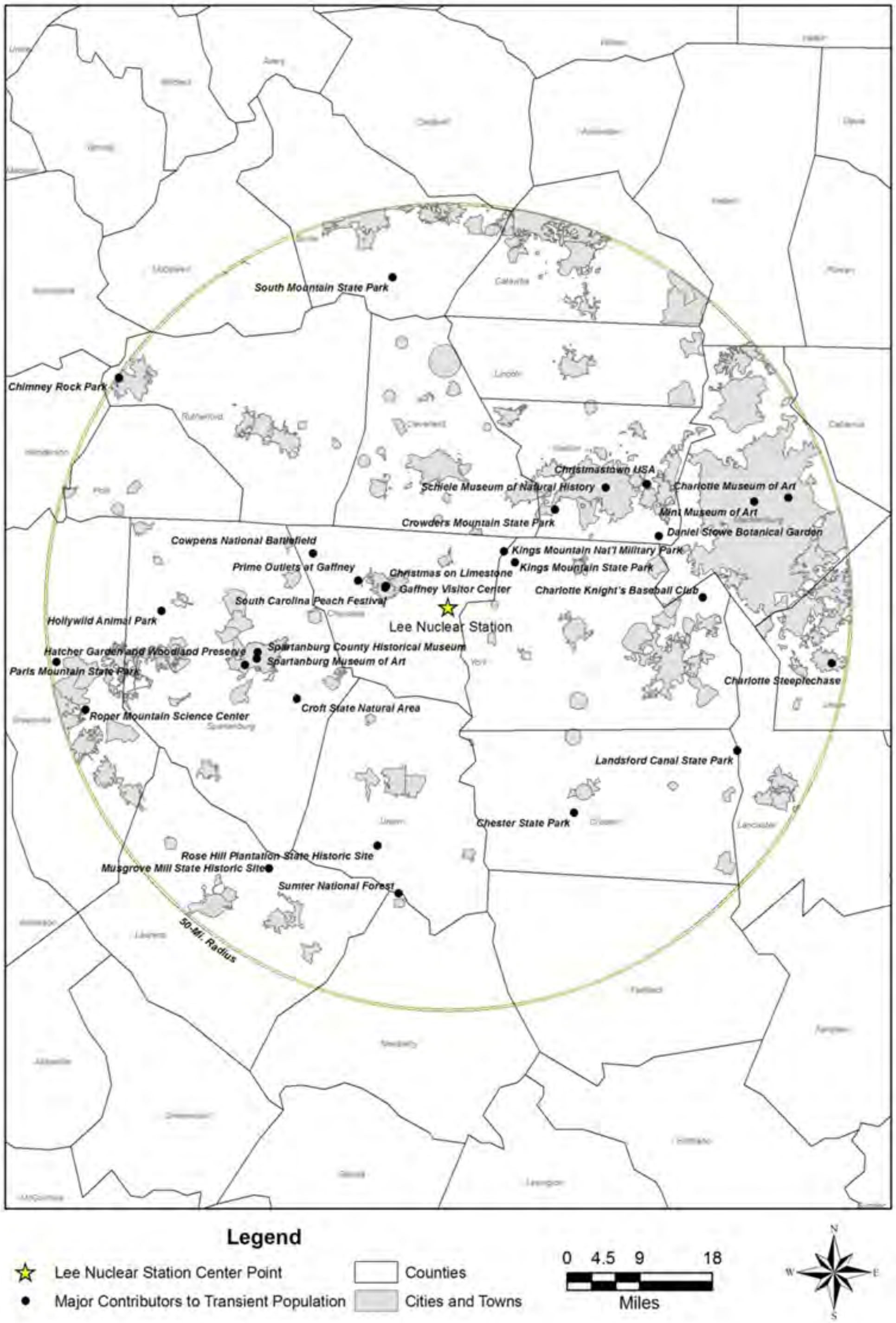

Figure 2-20. Location of Major Contributors to Transient Population (Duke 2009c)

Table 2-18. Minority and Low-Income Populations

	2000 Census		2010 ACS 5-Year Estimate	
	Percent Minority	**Percent Below Poverty**	**Percent Minority**	**Percent Below Poverty**
United States	24.9	12.4	35.3	13.8
South Carolina	32.8	14.1	35.5	16.4
Cherokee County	23.1	13.9	25.4	19.5
York County	22.8	10	26.7	12.5

Sources: USCB 2000a, b, c and USCB 2010e

Further discussion of the demographic composition of the analytical area is provided in Section 2.6. The remainder of this section focuses primarily on Cherokee and York Counties and addresses community characteristics, including the regional economy, transportation networks and infrastructure, taxes, aesthetics and recreation, housing, community infrastructure and public services, and education.

2.5.2.1 Economy

The principal economic centers in Cherokee and York Counties are Gaffney, South Carolina (Cherokee County); Blacksburg, South Carolina (Cherokee County); York, South Carolina (York County); Hickory Grove, South Carolina (York County); and Rock Hill (York County). In addition, because Charlotte, North Carolina (Mecklenburg County) is the largest economic center within the Lee Nuclear Station site 50-mi region, it is included in this section. Table 2-19 details employment by industry for Cherokee, York, and Mecklenburg Counties.

Local officials in Cherokee County, South Carolina, described the local economy as diverse and stable, despite the recent closure of textile mills, and believe the county's location off of I-85 near Charlotte positions it fairly well for industrial growth (NRC and PNNL 2008). Cherokee County has a diverse industrial base. Though manufacturing jobs declined 29.5 percent between 1994 and 2004, they remained the largest employment base in Cherokee County. Services, government, retail, and construction are the other major significant employment sectors in Cherokee County. Wholesale trade increased 72.9 percent between 1994 and 2004. In addition, the finance, insurance, real estate, transportation, and utilities sectors made considerable gains. Although no single employer dominates the county, the largest employers in Cherokee County are Nestlé USA (food production), Sander Brothers (construction), and Timken Company (machining), each with more than 1000 employees (Duke 2009c).

Table 2-19. Employment by Industry in the Economic Impact Area 2008

Year	Cherokee County 2008	York County 2008	Mecklenburg County 2008	Total 2008
Total employment	25,603	102,924	723,770	852,297
Wage and salary employment	21,219	81,488	605,422	708,129
Proprietors employment	4384	21,436	118,348	144,168
Farm	408	1339	481	2228
Agricultural services, forestry, fishing, and other	(D)	262	304	(NA)
Mining	(D)	91	651	(NA)
Construction	1895	6356	45,781	54,032
Manufacturing	6351	10,289	36,458	53,098
Transportation and utilities	1411	4085	(D)	(NA)
Wholesale trade	729	4696	42,612	48,037
Retail trade	2691	10,686	65,885	79,262
Finance, insurance, and real estate	1161	10,100	105,495	116,756
Services	7579	42,245	324,106	373,930
Government	2658	12,775	69,063	84,496

Source: BEA 2010
(D) = did not disclose
(NA) = not applicable

Currently, only 4 percent of the York County population works in the textile industry, compared to about 40 percent in the 1960s. York County has increased its manufacturing employment through industries such as plastics and machinery, mainly on the east side of the county. Most of the population in York County lives on the east side of the county around Rock Hill, which serves as a bedroom community to Charlotte, and along the North Carolina border near the I-77 and I-85 corridors (NRC and PNNL 2008).

Table 2-20 shows the size of the workforce, the number of workers employed, and the unemployment rates for Cherokee and York Counties for the 2007–2009 period. Recently, unemployment in the economic impact area has risen significantly because of economic conditions similar to those seen throughout the country associated with the economic downturn.

Table 2-20. Employment Trends for Cherokee and York Counties

	Cherokee County			York County		
	2007	2008	2009	2007	2008	2009
Labor force	25,220	25,567	26,063	104,215	107,789	112,094
Employed	23,521	23,228	21,782	98,652	100,159	96,185
Unemployed	1699	2339	4281	5563	7630	15,909
Unemployment rate (%)	6.7	9.1	16.4	5.3	7.1	14.2

Source: BLS 2011a

Table 2-21 shows median family income information covering the economic impact area based on the 2000 census and 2010 Housing and Urban Development estimates. Family incomes in Cherokee County grew at the same rate as the state average. However, family incomes in York County grew at a slower rate and appear to be noticeably lower than South Carolina as a whole. Family income in the economic impact area and in South Carolina as a whole grew at a slower rate than the rest of the country.

Table 2-21. Annual Median Family Income (Current Dollars) by County for the Economic Impact Area

County	2000 Median Family Income	2010 Median Family Income	2000 to 2010 Percent Change	2010 Index Versus South Carolina	2010 Index Versus United States
Cherokee County	39,393	49,600	25.9	0.890	0.770
York County	55,178	67,200	21.8	1.206	1.043
South Carolina	44,227	55,700	25.9	1.000	0.865
United States	50,046	64,400	28.7	1.156	1.000

Source: HUD 2011a, b, c

2.5.2.2 Taxes

South Carolina imposes a 6 percent sales and use tax on goods and certain services. Counties may impose an additional 1 percent local sales tax if voters within the county approve the tax. Both Cherokee and York Counties have a 1 percent local sales tax for a total tax of 7 percent (SCDOR 2008). Property tax is assessed on all real and personal property in South Carolina. A millage rate is applied to the assessed value of the property (4 percent for residences) to determine the tax. The average millage rate for South Carolina is 289 mills (0.289). The recently passed South Carolina Property Tax Relief law means homeowners are exempt from school property taxes for the first $100,000 of the value of their home (Carolina Living 2008).

Duke will pay all property taxes to Cherokee County. In 2007, Duke paid Cherokee County approximately $69,000 in property taxes (0.16 percent of Cherokee County 2007 property tax and fee-in-lieu revenue) for the Lee Nuclear Station site (Duke 2008f).

Table 2-22 identifies taxes collected by Cherokee County from 2002 to 2006. Based on ordinance 2005-20, passed by County Council of Cherokee County, South Carolina, Duke is entitled to make fee-in-lieu of tax payments, provided that the overall investment in the project is at least $2 billion (Duke 2008f). As part of this agreement, Duke would make fee-in-lieu payments at a rate of 2 percent of the taxable property value for the first 30 years of operation (Duke 2009c).

Table 2-22. Cherokee County Tax Collections by Category

	Fee Transfers From Other Counties - 1% Money, $	Fee-in-Lieu of Tax Collected, $	Penalties, Interest, and Costs on Collected Property Taxes, $	Delinquent Collections - Without Penalties or Interest, $	Motor Vehicle Collections, $	Current Collections - Without Penalties or Reimbursements, $
2002						
County	0.00	1,231,128.52	169,738.65	664,143.04	1,995,220.67	7,083,993.16
School	0.00	2,607,388.24	183,883.25	1,311,420.37	3,931,516.77	13,672,756.77
Special	0.00	207,768.94	9,524.74	55,571.29	142,851.41	498,875.48
Total	0.00	4,046,285.70	363,146.64	2,031,134.70	6,069,588.85	21,255,625.41
2003						
County	4,243.33	1,417,908.25	240,205.44	929,926.36	1,785,532.02	7,780,398.55
School	0.00	3,235,888.12	328,257.17	1,888,421.47	3,893,978.85	16,854,809.33
Special	0.00	254,056.93	12,918.13	68,364.02	141,620.58	567,064.33
Total	4,243.33	4,907,853.30	581,380.74	2,886,711.85	5,821,131.45	25,202,272.21
2004						
County	19,166.01	1,376,188.06	216,813.68	867,955.81	1,661,358.30	7,544,611.08
School	40,377.37	3,111,527.02	206,252.97	1,705,804.32	3,739,884.99	15,736,809.56
Special	0.00	259,953.57	8,193.25	65,020.01	136,704.07	602,590.14
Total	59,543.38	4,747,668.65	431,259.90	2,638,780.14	5,537,947.36	23,884,010.78
2005						
County	10,193.98	1,427,082.79	196,324.28	547,498.98	1,632,465.75	7,579,880.76
School	20,633.50	3,227,452.40	195,265.89	1,071,827.43	3,687,255.20	15,808,717.33
Special	0.00	257,221.12	7,487.12	37,348.59	137,299.68	622,320.12
Total	30,827.48	4,911,756.31	399,077.29	1,656,675.00	5,457,020.63	24,010,918.21
2006						
County	12,591.67	1,379,273.00	182,978.03	731,775.07	1,652,862.01	7,946,774.90
School	24,881.52	2,924,662.06	170,362.44	1,546,035.73	3,618,979.73	15,094,772.93
Special	0.00	253,820.21	7,058.43	57,968.47	140,397.01	610,775.90
Total	37,473.19	4,557,755.27	360,398.90	2,335,779.27	5,412,238.75	23,652,323.73

Source: Duke 2009c

Total 2009 taxes for Make-Up Pond C land were $68,869. Cherokee County will likely reassess the property as part of the Lee Nuclear Station site; however, this has not occurred so the reassessed value is unknown (Duke 2010c). In addition, it has not been decided if the Make-Up Pond C land will be included in the fee-in-lieu agreement.

2.5.2.3 Transportation

The transportation network for the Lee Nuclear Station site includes Federal and State highways, one primary freight rail service, and two primary commercial passenger airports. The Lee Nuclear Station site cannot be accessed by barge due to downstream dams.

Roads

Figure 2-21 illustrates the road network in Cherokee and York Counties and the surrounding region. I-85 is the closest highway to the Lee Nuclear Station site and runs from Spartanburg, South Carolina, through Cherokee County up to Gastonia, North Carolina. I-77 runs north to south through eastern York County from Rock Hill, South Carolina, and up to Charlotte, North Carolina. Workers in York County could use one of four South Carolina State Highways (i.e., SC 5, SC 55, SC 97, or SC 211) to gain access to the Lee Nuclear Station site. Currently, SC 5 is undergoing improvements that will allow for better access to the site from York County. Those commuting from Cherokee County could use one of three South Carolina State Highways (i.e., SC 5, SC 105, or SC 329). Access to the site is only available on McKowns Mountain Road (also known as County Road 13) on the southern side of the proposed site. Currently, about 950 vehicles travel McKowns Mountain Road between SC 105 and the end of the road everyday (Duke 2009c). According to Duke, there are approximately 74 property addresses for McKowns Mountain Road.

Air

Charlotte Douglas International Airport is located 34 mi northeast of the Lee Nuclear Station site. As of June 2006, 146 aircraft were based at Charlotte Douglas International Airport with an average of 1372 operations a day (47 percent commercial). Twenty-three aircraft are based at the Greenville-Spartanburg International Airport, approximately 41 mi west-southwest of the Lee Nuclear Station site. As of June 2006, Greenville-Spartanburg International Airport conducted 182 operations a day (11 percent commercial). Approximately 6 mi north of the Lee Nuclear Station site is a 25-ft square helipad at the Milliken and Company Heliport. No aircraft are based at the heliport (Duke 2009c).

Rail

The Southern Railroad Company owns and operates a small railroad spur that passes within a 5-mi radius of the proposed site and averages two freight trains per day. Southern Railroad Company also runs a major railroad line approximately 5.5 mi from the site that runs from Atlanta, Georgia to Charlotte, North Carolina and eventually to New York City, New York and New Orleans, Louisiana. This is primarily a freight line, with the exception of one passenger Amtrak Crescent train, and runs through downtown Gaffney and Blacksburg with an average of 22 trains per day. An abandoned railroad spur connects the main line running through Gaffney to the site. Duke plans to reactivate this railroad spur (Duke 2009c).

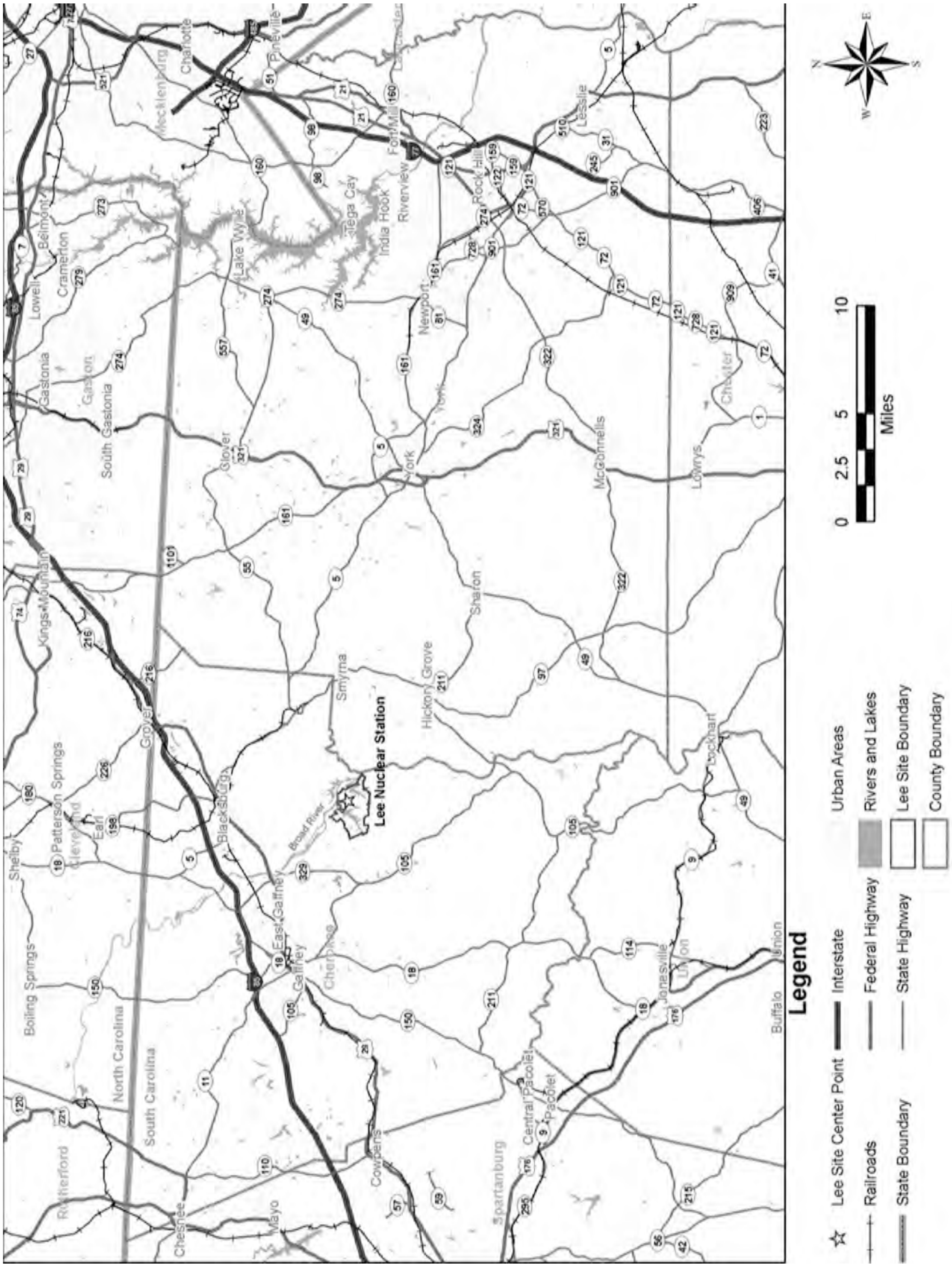

Figure 2-21. Transportation Network in Cherokee and York Counties (Duke 2009c)

The Southeast High-Speed Rail Corridor is proposed to run through this area on the existing tracks from Atlanta, Georgia, to Charlotte, North Carolina. This line would carry more than 1.6 million passengers annually (Duke 2009c).

Waterways

Proposed Lee Nuclear Station Units 1 and 2 are located near the Broad River, approximately 1 mi north of Ninety-Nine Islands Dam. According to the SCDNR, north of the site, the river is considered a State navigable water and is subject to permitting requirements pursuant to South Carolina R.19-450 under the State Navigable Waters Act (SCDNR 2008a). The section between the dam and the confluence with the Pacolet River is considered a State Scenic River.

2.5.2.4 Aesthetics and Recreation

Cherokee County is considered a Piedmont region, characterized by rolling hills, numerous tributaries, and, especially in the southeast, iron-rich red clay once hidden by ample deposits of topsoil. The county is entirely drained by the Broad River and its basin. Elevations at the Lee Nuclear Station site range from 437 to 816 ft above MSL. Original construction is not visible from surrounding areas.

Cherokee County contains 14 reservoirs and 1 lake, all with the potential to be used for various recreational activities, including hiking, fishing, and recreational swimming. Ninety-Nine Islands Reservoir is the closest to the Lee Nuclear Station site, directly adjacent to the eastern site boundary. Three recreational areas are identified on Ninety-Nine Islands Reservoir: Cherokee Ford Recreation Area; Pick Hill boat access; and an area on the east bank just south of the dam that has a canoe portage, tailrace fishing area, and boat ramp. Another public body of water near the Lee Nuclear Station site is Lake Cherokee, which is approximately 2 mi from the western site boundary (Duke 2009c).

Hunting, fishing, and wildlife watching in the region are recreational activities enjoyed by the public. These activities attract approximately 705,000 outdoor enthusiasts per year (Duke 2009c). Other recreational activities in the Lee Nuclear Station 50-mi region include local, State, and national park visitation, shopping, and community events. A list of recreational places and events are listed in Table 2-17, shown in Figure 2-20 and discussed in Section 2.5.1.2.

The closest park is Kings Mountain State Park (7.8 mi northeast) and Kings Mountain National Military Park, which adjoins the Kings Mountain State Park along its northwest border. Other nearby tourist attractions are Cowpens National Battlefield in Chesney, South Carolina; Gaffney Premium Outlets in Gaffney, South Carolina; and Sumter National Forest, located south of the Lee Nuclear Station site (Duke 2009c).

2.5.2.5 Housing

Many of the proposed Lee Nuclear Station Units 1 and 2 construction and operations workers are projected to live in Cherokee and York Counties in South Carolina, due to their proximity to the site. Cherokee County does not have any zoning or growth restrictions; however, York County has implemented a “smart growth” policy to prevent urban sprawl. There are boundaries for urban areas; however, it is still fairly easy to develop land for other uses, such as residential use. The proposed Lee Nuclear Station 50-mi region encompasses residential areas in and near cities and towns, smaller communities, and farms. Rental property is scarce in rural areas, but available in larger areas (e.g., Gaffney, East Gaffney, and Blacksburg, South Carolina). The majority of residents in the vicinity of the Lee Nuclear Station site are clustered in residential neighborhoods in the aforementioned cities. Outside the city limits, residents live in isolated, single-family homes or mobile homes (Duke 2009c). The median value for owner-occupied housing units in 2010 in Cherokee County was $82,700 and in York County was $158,900. The value for South Carolina was $134,100 (USCB 2010e).

Table 2-23 provides the number of housing units and vacancies for Cherokee and York Counties, the two counties where the review team expects Lee Nuclear Station site employees to reside. According to 2010 ACS, a total of 113,850 housing units are in the two counties. The average vacancy rate was 9.7 percent, with Cherokee County having the higher vacancy rate of the two counties and York County having the larger absolute number of vacant units (USCB 2010e).

Table 2-23. Regional Housing Information by County

County	Total Housing Unit	Occupied	Owner Occupied	Renter Occupied	Vacant Housing	Percent Vacancy
Cherokee	23,825	20,975	14,360	6615	2850	12.0
York	90,025	81,826	58,939	22,887	8199	9.1
Total	**113,850**	**102,801**	**73,299**	**29,502**	**11,049**	**9.7**

Source: USCB 2010e

2.5.2.6 Public Services

Water Supply and Waste Treatment

Duke is expected to obtain potable water for the Lee Nuclear Station site from the Draytonville Water System, which purchases its water from the City of Gaffney (Duke 2009c). Wastewater treatment will be handled by the Broad River Waste Water Treatment Plant (Duke 2010h). Groundwater use in this vicinity is limited to mainly individual residences and is not expected to be used at the Lee Nuclear Station (Duke 2009c).

There are two drinking-water-treatment plants in Cherokee County: the Victor Gaffney Plant and the Cherokee Plant, both of which are operated by the City of Gaffney. Victor Gaffney is the largest, with a maximum capacity of 12 Mgd. The Cherokee Plant, which completed upgrades in May 2007, has a capacity of 6 Mgd. The county currently draws approximately 8 Mgd. This water is used for local consumption and is sold to municipalities like Blacksburg, South Carolina, for resale and to water districts like Draytonville Water District. According to officials, water systems in Cherokee County are generally not operating at or near capacity (Duke 2009c).

Table 2-24 provides information on both drinking-water-treatment plants and the wastewater-treatment facilities in Cherokee County. The City of Gaffney operates both wastewater plants in Cherokee County. The Clary Plant is the largest with a maximum capacity of 5 Mgd and operates at a 60 percent capacity. The second plant is the Broad River Plant with a maximum capacity of 4 Mgd and is operating at a 40 percent capacity. The rural areas of Cherokee County use septic systems (Duke 2009c).

The largest provider of water in York County is the City of Rock Hill with a capacity of 26 Mgd and a current usage of approximately 22 Mgd. Most of York County receives its water from the City of Rock Hill, with a small portion from Charlotte, North Carolina; however, a majority of the western part of the county is on well or septic systems (NRC and PNNL 2008). York County has three wastewater-treatment plants with a combined capacity of 26 Mgd and current usage of 20.7 Mgd (EPA 2008b).

Table 2-24. Public Wastewater-Treatment and Water-Supply Facilities in Cherokee County

	Max Capacity (Mgd)	**Utilization (Mgd)**
Wastewater treatment		
Clary Plant	5	3
Broad River	4	1.6
Drinking water treatment		
Victor Gaffney Plant	12	5.28
Cherokee Plant	6	2.72

Source: Duke 2009c

Police, Fire, and Medical

The Cherokee County Sheriff's Department employs 42 officers and has police jurisdiction for all of Cherokee County, including the area immediately around the proposed Lee Nuclear Station. The Draytonville Volunteer Fire Department has firefighting jurisdiction for all of Cherokee County, including the area immediately around the proposed Lee Nuclear Station site. Gaffney and Blacksburg have the only other police departments in the county and employ approximately 40 and 14 full-time officers, respectively (FBI 2006). According to the U.S. Fire Administration's National Fire Department Census Database, Cherokee County has 12 fire departments with more than 350 volunteer and paid firefighters, but only Gaffney Fire Department employees are fully paid (USFA 2009). Cherokee County officials consider police and fire protection adequate, but expansion and facility upgrades may be needed to accommodate future population growth. Funding does exist in the county budget, however, to quickly increase staffing if needed (NRC and PNNL 2008). The York County Sheriff's Department employs 125 officers and has jurisdiction throughout York County. Rock Hill, York, Fort Mill, Tega Cay, and Clover all have city police departments (FBI 2006). York County also has 14 voluntary fire departments with approximately 1000 firefighters (both volunteer and career) (USFA 2009). Table 2-25 and Table 2-26 present police and fire statistics for Cherokee and York Counties.

Table 2-25. Police Departments in Cherokee and York Counties, 2005

	Total Law Enforcement Employees	Total Officers	Total Civilians
Cherokee County	90	42	48
Gaffney	44	40	4
Blacksburg	15	14	1
York County	262	125	137
Rock Hill	150	107	43
York	33	26	7
Fort Mill	31	25	6
Tega Cay	17	13	4
Clover	15	11	4

Source: FBI 2006

Table 2-26. Fire Statistics for Cherokee and York Counties

	Number of Fire Departments	Number of Stations	Career Firefighters	Volunteer Firefighters
Cherokee County	12	16	45	309
York County	14	24	110	973

Source: USFA 2009

Cherokee County's only hospital, Upstate Carolina Medical Center in Gaffney, has 125 beds and nearly 100 medical staff members. The current occupancy rate is 38 percent (Duke 2009c). Two nursing home facilities operate in Gaffney: Brookview Healthcare Center, which has 132 beds and 150 employees; and Peachtree Healthcare Center, which has 145 beds and 165 employees (Duke 2009c). The Cherokee County Health Department, also located in Gaffney, provides general medical services to between approximately 17,000 and

20,000 individuals per year. York County's primary hospital, Piedmont Medical Center in Rock Hill, has 288 beds. Rock Hill is also home to the York County Health Department (AHD 2013). Social services (e.g., adoptions, child protective services, family nutrition programs, foster care services, foster home and group home licensing, and food stamps) are overseen by the South Carolina Department of Social Services (Duke 2009c). Local officials stated the current level of health services is adequate, but funding is available in the budget to increase services if needed (NRC and PNNL 2008).

2.5.2.7 Education

Within the Lee Nuclear Station 50-mi region, 57 school districts with 799 schools supported a 2004 to 2005 student enrollment of 526,675 students (Duke 2009c). Five school districts in Cherokee and York Counties supported a 2008 to 2009 student enrollment of 48,200 students. One school district is in Cherokee County (Cherokee County Schools) and four are in York County (York County District 1, Clover School District, York County District 3, and Fort Mill School District). Two private schools in Cherokee County serve 150 students and eight private schools in York County serve approximately 1500 students (NCES 2008). The two school districts most likely to be affected by construction and operation of proposed Lee Nuclear Station Units 1 and 2 are Cherokee County and York County District 1. Table 2-27 provides school enrollment numbers for York and Cherokee Counties for the 2008 to 2009 school year.

For the 2008 to 2009 school year, Cherokee County Schools had 9360 enrolled students in 19 schools. A new primary school in Blacksburg was completed in 2006, and additions and renovations were completed at two other schools. Cherokee County passed a $45 million bond issue to fund stadium upgrades at two high schools and classroom additions and renovations at other schools (Duke 2009c). School officials reported $100 million worth of building construction and renovations in the past 10 years. In addition, 185 teachers have been hired, but only 100 additional students have enrolled (NRC and PNNL 2008).

Table 2-27. Number of Public Schools, Students, and Student/Teacher Ratios in Cherokee and York Counties for 2008-2009

	Number of Schools	Student Population	Student/ Teacher Ratio
Cherokee County			
Cherokee Independent School District	19	9360	14.8
York County			
York County District 1	8	5286	15.3
Clover School District	9	6445	16.2
York County District 3	28	17,664	16.5
Fort Mill School District	10	9445	14.5

Source: NCES 2010a, b

York County District 1, which covers most of the western portion of York County, is the largest district in the county based on geography but the smallest based on population. York County District 1 has a total enrollment of 5286 students in eight schools, three of which are over capacity; however, the district is undergoing construction and renovations, after which capacities should not be a problem for approximately 15 years (NRC and PNNL 2008). Local school officials estimated that Hickory Grove-Sharon Elementary would be impacted the most by construction of the proposed Lee Nuclear Station. Currently, Hickory Grove has an enrollment of 400 students but a capacity for 600 (NRC and PNNL 2008).

The Lee Nuclear Station 50-mi region is home to 33 two-year and four-year colleges and universities with a total student enrollment of more than 98,145. Limestone College in Gaffney, which has an enrollment of 700 students, is the closest college to the proposed site (Duke 2009c).

2.6 Environmental Justice

Environmental justice refers to a Federal policy established under Executive Order 12898 (59 FR 7629), which requires each Federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations.[a] The Council on Environmental Quality has provided guidance for addressing environmental justice (CEQ 1997). Although it is not subject to the Executive Order, the Commission has voluntarily committed to undertake environmental justice reviews. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040). The review team's environmental justice analysis is guided by the NRC's ESRP and the additional guidance document, Revision 1 of *Addressing Construction and Preconstruction Activities*, *Greenhouse Gas Issues*, *General Conformity Determinations*, *Environmental Justice*, *Need For Power*, *Cumulative Impact Analysis*, *and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements* (NRC 2011a).

This section describes the existing demographic and geographic characteristics of the proposed site and its surrounding communities. It offers a general description of minority and low-income populations within the region surrounding the Lee Nuclear Station site. The characterization in this section forms the analytical baseline from which potential environmental justice effects would be made. The characterization of populations of interest includes an assessment of "populations of particular interest or unusual circumstances" (NRC 2000a), such as minority

(a) Minority categories are defined as the following: American Indian or Alaskan Native; Asian; Native Hawaiian or other Pacific Islander; Black races; or Hispanic ethnicity; "other" may be considered a separate minority category. Low income refers to individuals living in households meeting the official poverty measure. To see the U.S. Census definition and values for 2000, visit the U.S. Census website at http://ask.census.gov/.

communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements.

The racial population is expressed in terms of the number and/or percentage of people that are minorities in an area, and, in this discussion, the sum of the racial minority populations is referred to as the aggregate racial minority population. Persons of Hispanic/Latino origin are considered an ethnic minority and may be of any race. The review team did not include Hispanics in its aggregate race estimate because the Federal government considers race and Hispanic origin to be two separate and distinct concepts (USCB 2011b). Table 2-28 shows the overall representation of the populations of interest in the Lee Nuclear Station 50-mi region and South Carolina as a whole.

Table 2-28. Regional Minority and Low-Income Populations by Census Blocks Meeting Environmental Justice Criteria

Category	Number of Blocks (out of 1766 Total)	Percent of Total
African American	301	17
Aggregate Minority	419	24
Hispanic	87	5
American Indian or Alaskan Native	1	0
Asian	20	1
Native Hawaiian or Other Pacific Islander	0	0
Persons Reporting Some Other Race	27	2
Low-Income Population	147	8

Source: Review team U.S. Census data analysis

2.6.1 Methodology

The review team first examined the geographic distribution of minority and low-income populations within 50 mi of the Lee Nuclear Station site, employing a geographic information system (GIS) and the 2006-2010 ACS 5-Year Summary data to identify minority and low-income populations. The location of minority and low-income populations within 50-mi of the proposed Lee Nuclear Station was analyzed using the ArcView® GIS software and 2006-2010 ACS 5-Year Summary data at the census block level (USCB 2011a, c).[(a)] The review team verified its analysis by conducting field inquiries with numerous agencies and groups (see Appendix B for contact lists). The first step in the review team's environmental justice methodology was to examine each census block group fully or partially included within the 50-mi region to determine

(a) A census block is the smallest geographic area that the U.S. Census Bureau collects and tabulates decennial census data. A block group is the next level above census blocks in the geographic hierarchy and is a subdivision of a census tract or block numbering area.

for each block group whether the percentage of any minority or low-income population was great enough to identify that block group as a minority or low-income population of interest. If either of the two criteria discussed below is met for a census block group, that census block group is considered either a minority or low-income population of interest warranting further investigation. The two criteria are described below:

- the population of interest that resides in the census block group exceeds 50 percent of the total population of the census block group, or
- the percentage of the population of interest in the census block group is significantly greater (at least 20 percentage points) than the minority or low-income population percentage in the respective state.

The identification of census block groups that meet either of the above two-part criteria is not sufficient for the review team to conclude that disproportionately high and adverse impacts exist. Likewise, the lack of census block groups meeting the above criteria cannot be construed as evidence of no disproportionate and adverse impacts. Accordingly, the review team conducts an active public outreach and on-the-ground investigation in the region of the proposed site to determine whether minority and low-income populations may exist in the region that are not identified in the census mapping exercise. To reach an environmental justice conclusion, starting with the identified populations of interest, the review team must examine impact pathways and investigate all populations in greater detail to determine whether disproportionately high and adverse effects may be present. To do this, the review team addresses the following considerations:

1. Health Considerations

- Are the radiological or other health effects significant or above generally accepted norms?
- Is the risk or rate of hazard significant and appreciably in excess of the general population?
- Do the radiological or other health effects occur in groups affected by cumulative or multiple adverse exposures from environmental hazards?

2. Environmental Considerations

- Is there an impact on the natural or physical environment that significantly and adversely affects a particular group?
- Are there any significant adverse impacts on a group that appreciably exceed or [are] likely to appreciably exceed those on the general population?
- Do the environmental effects occur in groups affected by cumulative or multiple adverse exposures from environmental hazards? (NRC 2007a).

If this investigation in greater detail does not yield any potentially high and adverse impacts on populations of interest, the review team may conclude that there are no disproportionately high and adverse effects. If, however, the review team finds any potentially disproportionate and adverse effects, the review team would fully characterize the nature and extent of that impact and consider possible mitigation measures that may be used to lessen that impact. The remainder of this section discusses the results of the search for potentially affected populations of interest.

2.6.1.1 Minority Populations

The racial population is expressed in terms of the number and/or percentage of people that are minorities in an area, and, in this discussion, the sum of the racial minority populations is referred to as the aggregate racial minority population. Persons of Hispanic/Latino origin are considered an ethnic minority and may be of any race; therefore, they are not included in the aggregate racial minority population. The review team did not include Hispanics in its aggregate race estimate because the Federal government considers race and Hispanic origin to be two separate and distinct concepts (USCB 2011b).

The review team estimated that in 2010, 1766 census block groups were wholly or partially within the Lee Nuclear Station 50-mi region. Using the individual comparison criteria (i.e., comparing the block group to the state in which it is located), GIS analysis found the following census block groups with populations of interest: 301 block groups have African American populations, 87 have Hispanic ethnicity populations, 1 has an American Indian or Alaskan Native population, 20 have Asian populations, and 27 have “some other race” populations. The review team identified 419 block groups with aggregate minority plus Hispanic populations. No blocks were identified with minority populations of interest for Hawaiians or other Pacific Islanders (USCB 2011a, c). The closest aggregate minority population to Lee Nuclear Station Units 1 and 2 is about 7 mi west, in the town of Gaffney. Figure 2-22 shows the geographic location of aggregate minority block groups.

2.6.1.2 Low-Income Populations

South Carolina’s statewide low-income population measured 16.4 percent in 2010. Within the Lee Nuclear Station 50-mi region, 147 out of 1766 census block groups have low-income populations of interest (USCB 2011a, c). This represents 8.3 percent of the census block groups. The closest low-income block group to Lee Nuclear Station Units 1 and 2 is approximately 7 mi west, in the town of Gaffney. Figure 2-23 shows the geographic location of low-income block groups.

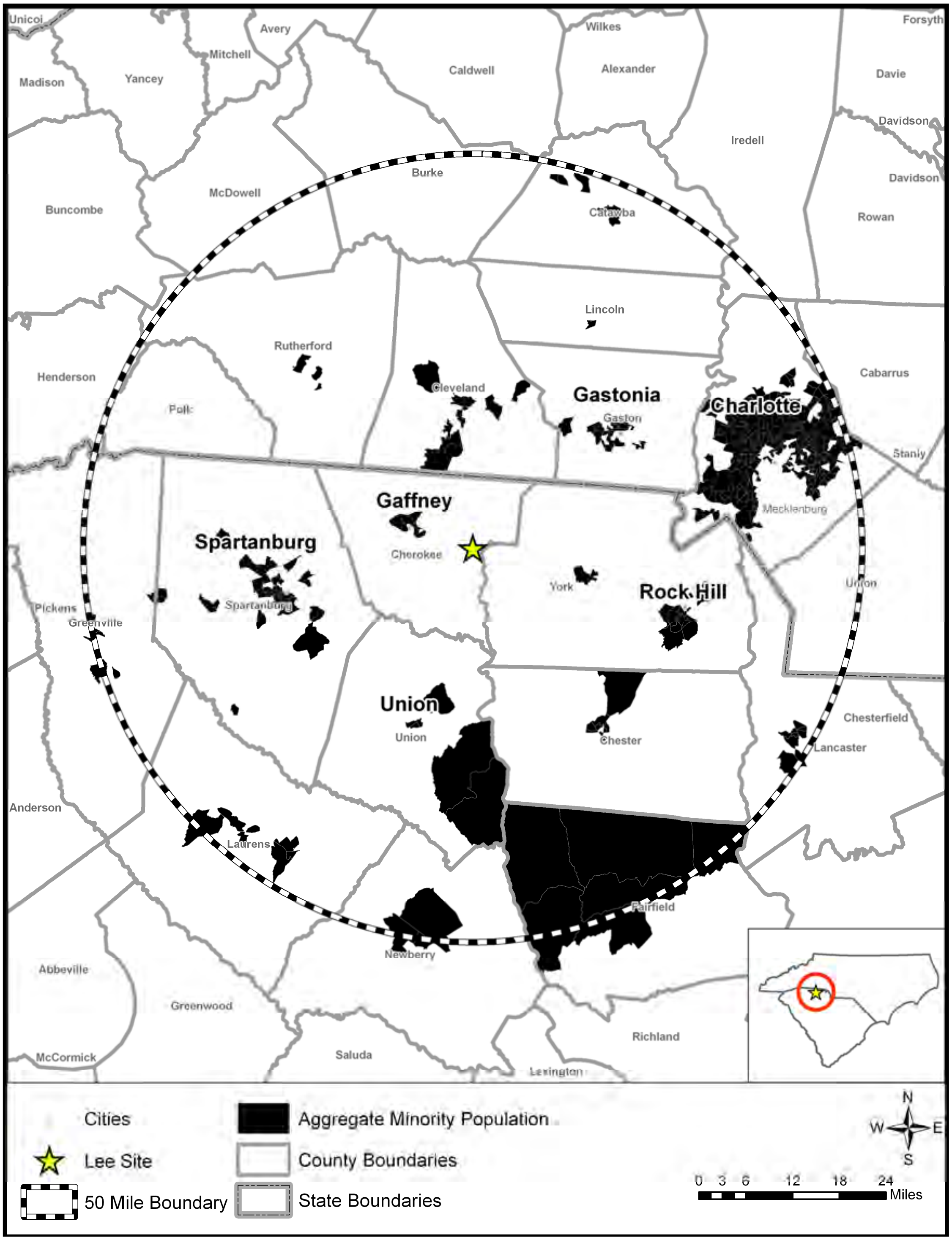

Figure 2-22. Aggregate Minority Populations (USCB 2011a, c)

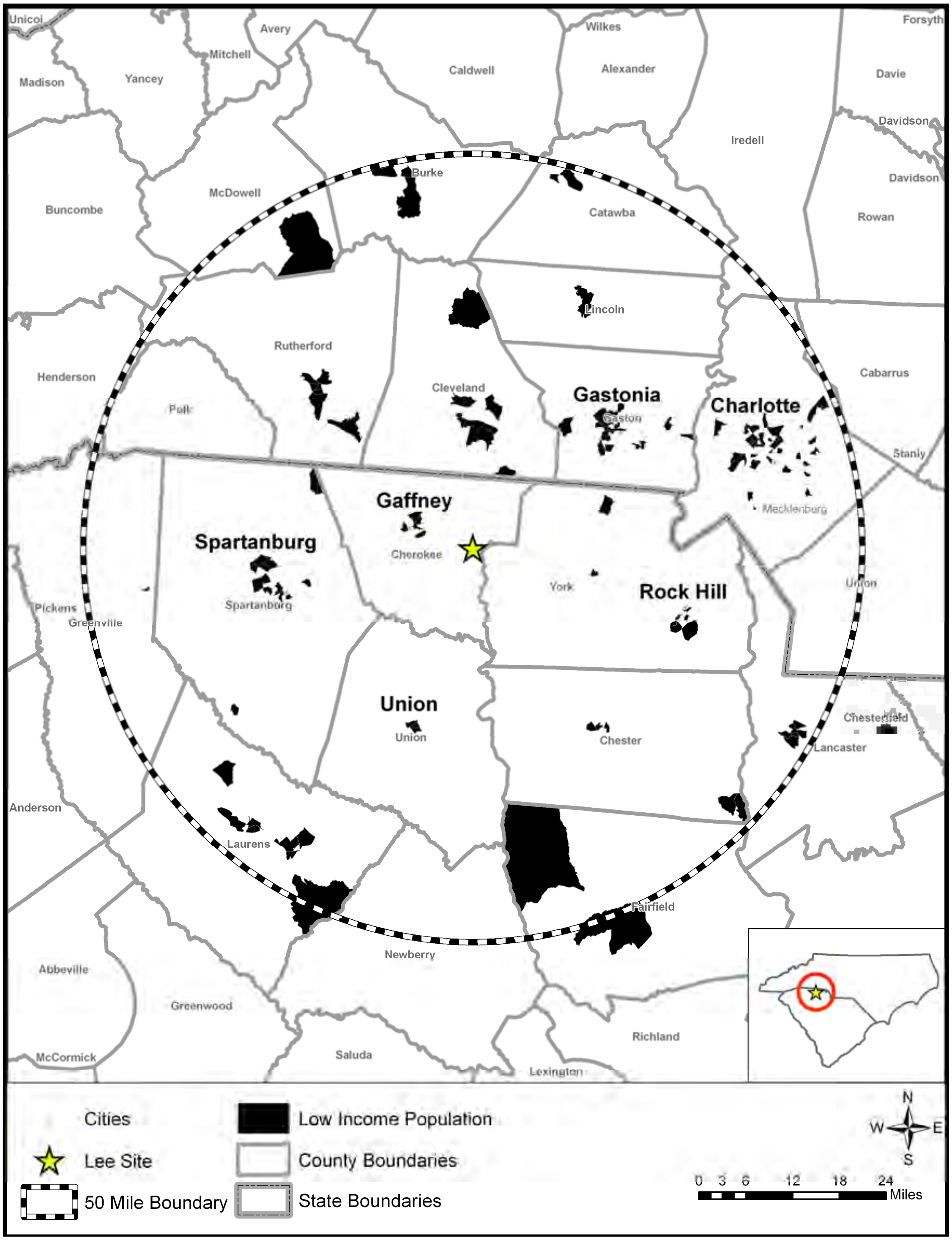

Figure 2-23. Low-Income Populations (USCB 2011a, c)

2.6.2 Scoping and Outreach

During the development of its ER, Duke interviewed community leaders of the minority populations within the analytical area. The review team built upon this base and performed additional interviews in the analytical area with the potential for the greatest environmental and socioeconomic effects. The review team interviewed local and county officials, business leaders, and key members of minority communities in Cherokee and York Counties to assess the potential for disproportionate environmental and socioeconomic effects that may be experienced by minority and low-income communities impacted by building and operating proposed Lee Nuclear Station Units 1 and 2. In accordance with NRC guidance, the review team provided advance notice of public hearings for EIS scoping purposes (see Appendix D). These activities did not identify any additional groups of minority or low-income persons not already identified in the GIS analysis of census data.

2.6.3 Subsistence and Communities with Unique Characteristics

For each of the identified low-income and minority groups, the staff must determine if any of the identified populations of interest, or any other populations, appears to have a unique characteristic that would cause it to be subject to disproportionately high and adverse effects. Examples of unique characteristics might include lack of vehicles, sensitivity to noise, close proximity to the plant, or subsistence activities. Such unique characteristics need to be demonstrably present in the population and relevant to the potential environmental impacts of the plant. If the impacts from the proposed action would appear to affect an identified minority or low-income population more than the general population because of one of these or other unique characteristics, then a determination is made whether the impact is disproportionate when compared to the general population.

Subsistence uses of natural resources often supplement income by providing food or other resources that free up actual earnings for additional store-bought foodstuffs, medications, or other needs. Further, subsistence is sometimes undertaken for ceremonial and traditional cultural purposes. Subsistence is generally considered to be the use of publicly held resources such as rivers (subsistence fishing) or forests (hunting or gathering of vegetation); however, subsistence use of privately owned resources, such as home vegetable gardens, is also applicable. Typical categories of subsistence uses include gathering plants, fishing, and hunting. Subsistence information is often site-specific and difficult to differentiate from the recreational uses of natural resources. Therefore, the review team presents subsistence information in a more qualitative manner based on diverse sources of published and anecdotal information.

The general public is not allowed uncontrolled access to the site for safety and security reasons; thus, no ceremonial, culturally significant, or subsistence gathering of vegetation occurs on the site. No information for plant gathering could be found in the vicinity of the Lee Nuclear Station site. Therefore, the review team assumes that if collection of plants for ceremonial, cultural, or subsistence purposes is occurring, that collection is taking place at a de minimis level. During its community outreach, the review team interviewed several individuals with knowledge of low-income and minority communities in the region. The review team only found one person who witnessed subsistence fishing activities, and those activities were confined to ponds, creeks, streams, and Lake Wiley in York County (Niemeyer 2008). Through its review of the applicant's ER, its own outreach and research (NRC and PNNL 2008), and through scoping meeting comments, the review did not identify any potentially unique communities with characteristics that warranted further consideration.

2.6.4 Migrant Populations

The U.S. Census Bureau defines a migrant worker as an individual employed in the agricultural industry in a seasonal or temporary nature, and who is required to be absent overnight from their permanent place of residence. Migrant workers can be members of minority or low-income populations. Because they travel and can spend a significant amount of time in an area without being actual residents, migrant workers may be unavailable for counting by census takers.

From an environmental justice perspective, potential exists for such groups in some circumstances to be disproportionately affected by emissions in the environment. Eight of the 416 farms in Cherokee County and 13 of the 1036 farms in York County employ migrant workers (USDA 2009a). Additionally, interviews with local officials indicated a small pocket of migrant workers in Cherokee and York Counties were employed at peach orchards and construction sites (NRC and PNNL 2008).

2.6.5 Environmental Justice Summary

The review team found low-income, Black, Hispanic, American Indian or Alaska Native, Asian, and aggregated minority populations within the 50-mi radius that exceed the percentage criteria established for environmental justice analyses. Consequently, the staff performed additional analyses before making a final environmental justice determination. Sections 4.5 and 5.5 of this EIS present the environmental justice impacts of construction and operation, respectively, of Lee Nuclear Station Units 1 and 2.

2.7 Historic and Cultural Resources

In accordance with 36 CFR 800.8(c), the NRC and the USACE have elected to use the NEPA process to comply with the obligations found under Section 106 of the National Historic Preservation Act, as amended (NHPA). As a cooperating agency, the USACE is part of the review team, and is involved in all aspects of the historic and cultural resources portion of the COL review for proposed Lee Nuclear Station Units 1 and 2.

The review team has identified direct (physical) and indirect (visual) areas of potential effect (APEs) at the Lee Nuclear Station site, in the 6-mi vicinity of the proposed plant, and in offsite areas for the environmental review. The NRC has determined that the direct, physical APE for this COL review is the area at the Lee Nuclear Station site and its immediate environs that may be impacted by proposed ground-disturbing activities associated with building and operating proposed Lee Nuclear Station Units 1 and 2. The onsite indirect APE that encompasses potential visual impacts for this COL review is located within the Lee Nuclear Station site vicinity and is defined as a zone within 1 mi of the tallest structures associated with the proposed new units. For the USACE, additional direct and indirect APEs are defined for other plant components in the Lee Nuclear Station site and vicinity including proposed onsite utilities, grading areas, spoil piles, laydown areas, and a railroad turnaround, Make-Up Pond C and associated developments, reactivation and modification of an offsite railroad spur, new offsite transmission lines, and new offsite transportation improvements. Indirect, visual APEs associated with these proposed plant components include a zone within 1 mi of the onsite utilities, within 1.25 mi of the shoreline of Make-Up Pond C, within 300 ft of the railroad line, and within 0.5 mi of the transmission lines. For the purposes of NHPA Section 106 review, the USACE will conduct ongoing and future consultation with the South Carolina State Historic Preservation Officer (SHPO), appropriate Tribal Historic Preservation Officers (THPOs), and Duke for onsite and offsite preconstruction activities as well as any future APEs or inadvertent discoveries according to the Lee Nuclear Station site cultural resources management plan and Memorandum of Agreement (MOA) (USACE et al. 2013).

This section provides an overview of the historic and cultural background of the Lee Nuclear Station site and region. Onsite and offsite direct (physical) and indirect (visual) APEs are also discussed, including the efforts that have been taken to identify historic properties and cultural resources within them. Historic properties (resources eligible or potentially eligible for nomination to the National Register of Historic Places [National Register]) and other cultural resources identified as a result of these efforts are included in the discussion and additional detail on these resources is included in Appendix G. The discussion also includes a description of the coordination and consultation efforts accomplished to date, with references to Appendices C and F for additional information. Assessments of effects relative to construction of proposed Lee Nuclear Station Units 1 and 2 and preconstruction of various onsite developments, Make-Up Pond C, and offsite plant components such as the railroad line, proposed new transmission lines, and transportation improvements are provided in Section 4.6; associated assessments relative to operations are provided in Section 5.6. Cumulative effects of construction and preconstruction are discussed in Section 7.5.

2.7.1 Cultural Background

This section provides an overview and summary of the cultural history of the Lee Nuclear Station site and surrounding region based on documentation provided in cultural resources survey reports completed by Duke's primary cultural resources contractor, Brockington and Associates, Inc. (Brockington 2007a). The area in and around the Lee Nuclear Station site has a rich cultural history and a substantial record of significant prehistoric and historic resources, with evidence of continuous settlement for at least the past 12,000 years. Prehistoric occupation is traditionally divided into four periods:

- Paleo-Indian (12,000 to 8000 BC)—This period is typically characterized by the presence of small mobile bands dependent upon large game, and to some extent upon smaller aquatic and terrestrial game and flora. Archaeological evidence of Paleo-Indian settlement is rare in Cherokee County and in the general vicinity of the Lee Nuclear Station site.
- Archaic (8000 to 1500 BC)—The Archaic period is divided into early, middle, and late sub periods defined on the basis of changing diagnostic projectile point typologies and evolving resource procurement strategies. During this period, people appear to have become increasingly sedentary and adept at exploiting resources found within their environment, resulting in an overall increase in population. The late Archaic period is characterized by the presence of sand-tempered pottery, which arrived at the Piedmont region via the coastal plain. The majority of prehistoric archaeological sites recorded on and in proximity to the Lee Nuclear Station site have components associated with the middle and late Archaic sub periods.
- Woodland (1500 BC to 900 AD)—The Woodland period is also divided into early, middle, and late sub periods characterized by changing pottery types. During this time in the Piedmont region, bow and arrow technology is employed and evidence exists of extensive use of pottery, reliance upon freshwater shellfish, and development of larger settlements located along major river terraces, where horticulture was practiced. Evidence of food preservation and storage is also found, indicating population growth. Archaeological evidence of this period is found at the Lee Nuclear Station site and in the Make-Up Pond C area.
- Mississippian (900 AD to 1550 AD)—This period is characterized by ceremonial mounds, distinctive mortuary practices, and large agriculture-based settlements generally considered to have been controlled by chiefdoms. Very few archaeological sites associated with this period have been found on the Lee Nuclear Station site or in the immediate vicinity.

The Historic period in the vicinity of the Lee Nuclear Station site begins with the arrival of Hernando de Soto, a Spanish explorer who traveled the interior of the Southeast during the mid-sixteenth century. The Cherokee County area was a buffer zone between the warring Catawba and Cherokee Tribes during the sixteenth and seventeenth centuries. During the late seventeenth century, colonial settlers of European descent traded with Cherokee Tribes and lived in relative peace with them. However, by the middle-to-late eighteenth century and during the American Revolutionary War (1775 to 1783), Euro-American settlements had encroached upon Cherokee lands, resulting in numerous battles and conflicts between the two groups that ultimately devastated the American Indian population.

In the late eighteenth and early nineteenth centuries, Euro-Americans began settling on small farms in the region with cotton being the dominant crop. National Register-eligible farmsteads identified along proposed Lee Nuclear Station Units 1 and 2 offsite transmission-line corridors (Smiths Ford Farm and Reid-Walker-Johnson Farm) are associated with these efforts. Iron smelting also played a significant role in the area's economy during the nineteenth century, with several furnaces located near the Lee Nuclear Station site, including the National Register-eligible Ellen Furnace located along the Lee Nuclear Station railroad line. After the Civil War (1861 to 1865), railroad expansion and the growth of textile manufacturing in the region prompted considerable growth, including the establishment of the Town of Gaffney in 1875 and the creation of Cherokee County in 1897. Introduction of hydropower in the late nineteenth and early twentieth centuries provided additional support for the expanding textile industry in the region. The National Register-eligible Ninety-Nine Islands Dam and Ninety-Nine Islands Hydroelectric Project, located on the Broad River adjacent to the Lee Nuclear Station site, are associated with this era.

2.7.2 Historic and Cultural Resources at the Site and Vicinity

The following sections describe historic properties and cultural resources located within the direct (physical) and indirect (visual) APEs at the Lee Nuclear Station site, at Make-Up Pond C, and at offsite plant developments (railroad line, new transmission lines, transportation improvements). To gain a general understanding of all resources in the vicinity of the Lee Nuclear Station site, Duke initially assembled information on National Register-eligible archaeological sites, structures, buildings, and districts located within 10 mi of the Lee Nuclear Station site (Duke 2009c). There are 118 previously recorded archaeological sites in this large area and aboveground architectural resources include 69 individual properties and another 184 properties contained within the boundaries of National Register-listed historic districts (Gaffney Commercial Historic District, Limestone Springs Historic District, Hill Complex Historic District, and Sharon Downtown Historic District), and one National Register-listed national military park (Kings Mountain National Military Park) (Duke 2009c).

Cultural resources investigations of the Lee Nuclear Station site began in the early 1970s for the unfinished Cherokee Nuclear Station and continue now as additional project components needed to support the building and operation of the proposed Lee Nuclear Station are identified. Figure 2-24 illustrates the main APEs that have been identified to date.

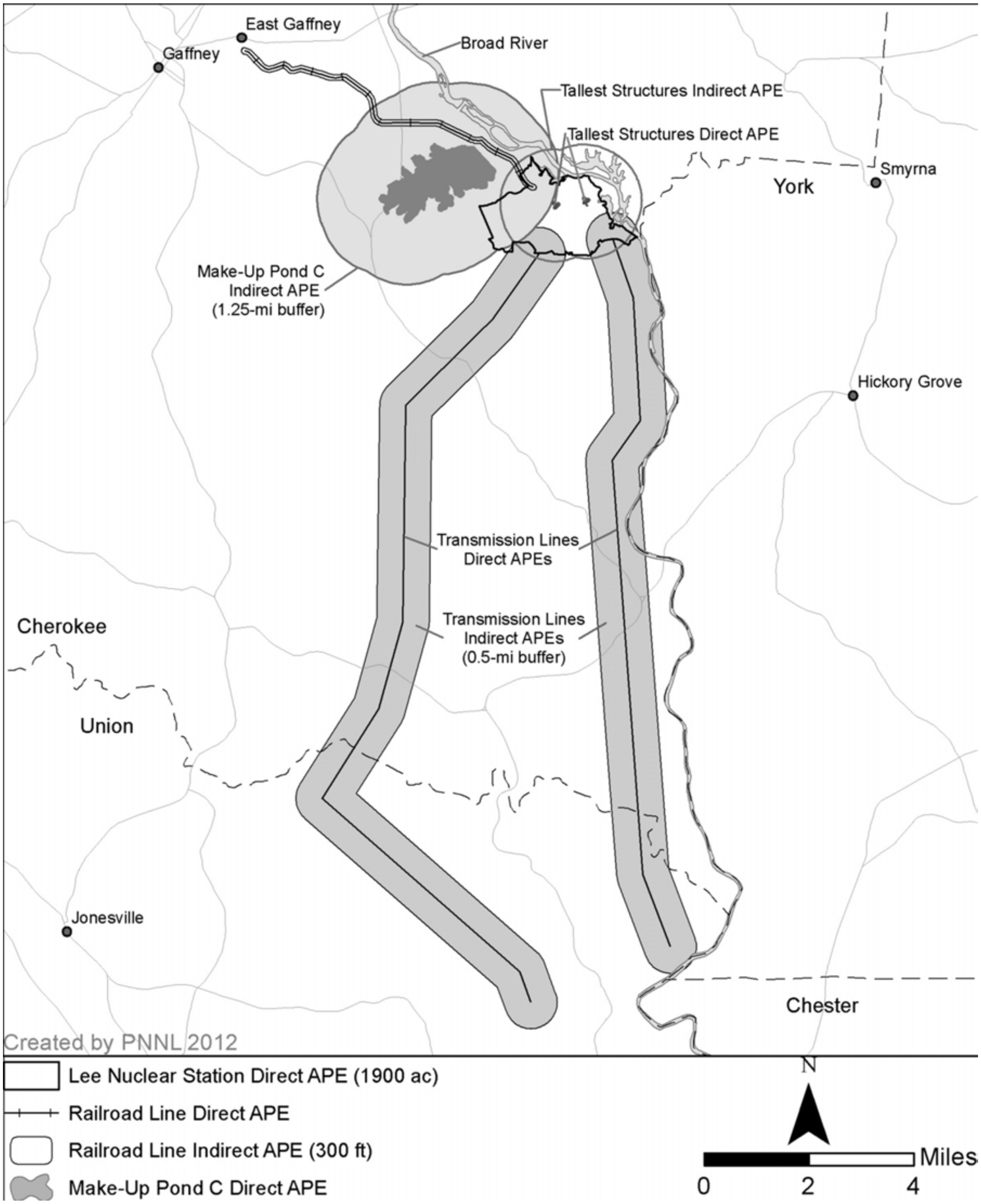

Figure 2-24. Main Areas of Potential Effect for the Lee Nuclear Station Site and Offsite Developments

Duke has engaged the South Carolina SHPO in discussions to define all APEs, and interested American Indian Tribes and organizations have also been provided with information (primarily the Catawba Indian Nation, Eastern Band of Cherokee Indians, and Seminole Tribe of Florida) and opportunities to comment. A substantial record of correspondence between Duke and these interested parties documents these efforts; the overall SHPO and Tribal interest in the projects; and their concurrence with the approach to identifying, evaluating, and assessing potential impacts to historic properties and cultural resources. The record of Duke's coordination with these parties is available in Appendix B of the ER (Duke 2009c), in various cultural resources reports (Brockington 2009a), or has been provided separately to the review team by Duke (Duke 2008f; 2009h, i; 2010i, j; 2012d). The NRC has also initiated consultation with these and other groups, as discussed in Section 2.7.4 and Appendix F.

The discussions to follow are based on the cultural resources reports prepared for the APEs that have been defined and investigated to date, including the following primary references:

- Lee Nuclear Station Units 1 and 2 COL ER (Duke 2009c) and the supplement to the ER specific to Make-Up Pond C (Duke 2009c)
- Cultural resources investigations completed by the South Carolina Institute of Archaeology and Anthropology (SCIAA) of developments associated with the unfinished 750 ac Cherokee Nuclear Station (SCIAA 1974), the Gaffney By-Pass (SCIAA 1977), and the proposed Cherokee Transmission Lines (SCIAA 1981)
- 2007, 2009, and 2013 cultural resources surveys of proposed developments in the 1900 ac Lee Nuclear Station site by Duke's primary cultural resources contractor, Brockington and Associates, Inc. (Brockington 2007a, b, 2009a, 2013)
- 2009, 2010, 2011, and 2013 cultural resources surveys of Make-Up Pond C and associated developments (Brockington 2009b, 2010, 2011, 2013)
- 2007 cultural resources survey of the offsite railroad line (Brockington 2007c)
- Duke's 2007 siting study for offsite transmission lines (Duke 2007c), a 2009 cultural resources survey of the preferred routes completed by Archaeological Consultants of the Carolinas, Inc. (ACC 2009), and a 2010 visual impact assessment along the preferred routes (Pike Electric 2010)
- 2012 cultural resources record search and field review of offsite transportation improvements (Duke 2012d)

Onsite Direct Areas of Potential Effect

The first cultural resources surveys completed at the Lee Nuclear Station site were initiated in the 1970s as part of environmental evaluations of the proposed Cherokee Nuclear Station (Duke Power Company 1974a). At this time, investigators from the SCIAA at the University of

South Carolina documented 11 archaeological sites and a historic cemetery within what is now the Lee Nuclear Station site and a few additional sites nearby (Duke 2009c; SCIAA 1974). This included five prehistoric archaeological resources (38CK8, 38CK9, 38CK10, 38CK11, 38CK13), four historic archaeological sites (38CK16, 38CK17, 38CK18), three archaeological sites with both prehistoric and historic components (38CK12, 38CK14, 38CK15), and one historic cemetery (38CK19/Stroup Cemetery). Investigators concluded that most of these resources were not significant archaeological sites (SCIAA 1974); only one prehistoric archaeological site (38CK8) and the historic Borden’s Ferry (38CK16) were recommended for further investigations (SCIAA 1974), indicating that they exhibited some potential for further research and National Register eligibility. Investigators also recommended additional documentation and protection of the historic Stroup Cemetery (38CK19). In 1975, the South Carolina SHPO concluded that no National Register properties would be affected by the proposed Cherokee Nuclear Station (Duke 2009c). No architectural resources or potential indirect visual effects were investigated during these surveys.

Between 1977 and 1982, a 750-ac area within the onsite direct APE was extensively disturbed to a depth of at least 30 ft during onsite preparations for the Cherokee Nuclear Station (Duke 2009c). It is likely that half of the archaeological sites recorded during the 1974 survey (SCIAA 1974) were destroyed by these activities (38CK10, 38CK11, 38CK12, 38CK13, 38CK17, 38CK18) (Duke 2009c; Brockington 2007a). This was at least partially confirmed during a subsequent archaeological survey for proposed transmission lines (SCIAA 1981). Given the original evaluations for no further investigations at all of these resources, it is unlikely that any were eligible for nomination to the National Register. The six remaining archaeological resources originally recorded in the 1970s were probably not disturbed by site preparations made for the Cherokee Nuclear Station (38CK8, 38CK9, 38CK14, 38CK15, 38CK16, and 38CK19/Stroup Cemetery) (Duke 2009c).

Beginning in 2007, Duke contracted with Secretary of Interior-qualified cultural resources contractor Brockington and Associates, Inc., to conduct archaeological surveys, including shovel testing of onsite direct physical APEs, and architectural surveys within onsite indirect visual APEs, to support the COL review for Lee Nuclear Station Units 1 and 2. Field methods, background research, and project reporting were completed for all of these investigations in accordance with Federal and South Carolina guidelines (48 FR 44716; CSCPA 2005; SCDAH 2007a).

In 2007, Brockington and Associates, Inc. completed archaeological investigations within onsite direct, physical APEs, including a proposed water-intake structure, road-improvement corridor, and a meteorological tower location (Brockington 2007a, b). During these investigations, disturbance of the original 750-ac area associated with preparations for the Cherokee Nuclear Station in the 1970s was confirmed (Brockington 2007a). One of the six archaeological sites that was not disturbed by previous preparations for the Cherokee Nuclear Station (38CK14) was reportedly located in proximity to the overlook road surveyed at this time; however, no evidence of this site could be found despite intensive survey and test excavations (Brockington 2007a). Additionally, no new archaeological sites were identified (Brockington 2007a, b). The South Carolina SHPO accepted the 2007 survey report and addendum without specifically commenting on the eligibility of archaeological sites or the probable destruction of resources originally recorded in the 1970s and requested negotiation of an agreement to cover future cultural resources assessments associated with the building and operation of the Lee Nuclear Station (SCDAH 2007b).

In 2009, Brockington and Associates, Inc. returned to the Lee Nuclear Station site to complete investigations of additional direct, physical APEs for proposed onsite utilities and developments (Brockington 2009a). Two archaeological sites previously recorded in 1974 were included in these APEs; site 38CK14 in a proposed site-preparation spoils APE and 38CK15 in a rebar laydown APE. In spite of shovel tests and careful ground inspections, no evidence of these sites remained (Brockington 2009a). Surveys and shovel testing in 2009 also resulted in the documentation of one new archaeological isolate (two fragments of aqua window glass) and three new archaeological sites: 38CK138 (prehistoric lithic scatter and nineteenth-century artifacts) in the proposed wastewater line APE; 38CK139 (late nineteenth-century artifact scatter) in the onsite transmission corridor APE; and 38CK143 (prehistoric lithic scatter and nineteenth- and twentieth-century artifacts) in the site-preparation spoils APE. All of these resources exhibited low artifact frequencies, lack of potential for intact subsurface features, lack of integrity due to erosion and previous ground disturbance, and no potential for generating additional important information concerning past settlement patterns or land-use practices (Brockington 2009a). As a result, the South Carolina SHPO concurred with the investigators evaluation that all are ineligible for nomination to the National Register (SCDAH 2009a).

In 2012 and 2013, Duke updated plans for the design and placement of site-specific structures, system, and components at the Lee Nuclear Station site (Duke 2013c), making minor changes to the locations of Units 1 and 2 and associated components; refining plans for spoils, laydown, and grading areas; and designing a new railroad turnaround. Under the guidance of the Lee Nuclear Station cultural resources management plan and associated MOA (USACE et al. 2013), cultural resources investigations were completed of these new proposed developments (Brockington 2013). Surveys and shovel testing resulted in the documentation of four new archaeological sites in direct, physical APEs within the Lee Nuclear Station site: 38CK185 (late nineteenth- and early twentieth-century homesite), 38CK186 (nineteenth-century artifact scatter), and 38CK187 and 38 CK188 (prehistoric lithic scatters). Seven isolated prehistoric artifact finds were also documented, including one Middle Archaic projectile point. All of the identified resources were evaluated by investigators as ineligible for nomination to the National Register (Brockington 2013) and the South Carolina SHPO concurred with these findings (SCDAH 2013).

During each of the 2007, 2009, and 2013 investigations of onsite direct APEs, historic cemeteries known to be located within the 1900 ac Lee Nuclear Station site were revisited and confirmed to be outside all direct, physical APEs (Brockington 2007b). All four of the historic cemeteries located within the 1900-ac Lee Nuclear Station site, including the Stroup Cemetery (38CK19), an unnamed cemetery, Moss Cemetery (38CK141), and the McKown Family Cemetery, are protected by several South Carolina statutes (SC Code Ann 16-17-600, and SC Code Ann 27-43, summary also found in CSCPA 2005). Although historic cemeteries are generally not eligible for nomination to the National Register, they are often culturally important to local members of the community. Periodic requests for access to the identified historic cemeteries continue to be received and Duke has recognized the importance of continued public access, avoidance of ground disturbance, and maintenance of the fences that currently define these sensitive areas (Duke 2010d). These protections are also integral to the Lee Nuclear Station site cultural resources management plan and MOA (USACE et al. 2013). Following the guidance of the cultural resources management plan and MOA, 50-ft protective buffers will be established around the Stroup Cemetery (38CK19) and the McKown Family Cemetery during onsite land-disturbance activities associated with grading and spoil disposal to ensure they are not impacted by work activities nearby (Brockington 2013; Duke 2013c).

A summary of the archaeological resources and historic cemeteries identified within onsite direct, physical APEs at the 1900-ac Lee Nuclear Station site is provided in Appendix G.

Onsite Indirect Areas of Potential Effect

Architectural surveys to assess indirect, visual effects resulting from onsite developments were also completed by Brockington and Associates, Inc. in 2007 and 2009 (Brockington 2007a, b, 2009a). The indirect, visual APE for these surveys was defined in coordination with the South Carolina SHPO as a 1-mi radius around the tallest proposed structures, including the proposed nuclear units, associated shield buildings, and the meteorological tower. Field and archival investigations documented 12 architectural resources in this APE, including several twentieth-century houses, a twentieth-century church and associated cemetery and outbuildings, and a previously recorded National Register-eligible industrial property—the twentieth-century Ninety-Nine Islands Dam and Power Plant (Brockington 2007a, b; 2009a). The 1-mi radius indirect, visual APE also accommodates proposed 2012 plant configuration changes and updated 2013 plans for associated developments such as spoil, laydown, and grading areas and a new railroad turnaround (Duke 2013c) and no additional architectural surveys were completed for these changes (Brockington 2013).

All of the identified architectural resources were evaluated against a broad historic overview and context highlighting important themes in the history of the region developed by Brockington and Associates, Inc. (Duke 2008g). Based on this context, the newly recorded architectural resources were not associated with any significant historical development in the region and were therefore evaluated as ineligible for nomination to the National Register (Brockington

2007a, b; 2009a). However, the previously recorded Ninety-Nine Islands Dam and Ninety-Nine Islands Hydroelectric Project property also located within the onsite indirect, visual APE was evaluated as eligible for nomination based on the unique design and association with early twentieth-century hydropower development in the Piedmont region of South Carolina (Brockington 2009a). The South Carolina SHPO concurred with these evaluations (SCDAH 2007b, 2009a).

A summary of the architectural resources identified within the onsite indirect, visual APE associated with the Lee Nuclear Station site is provided in Appendix G.

Make-Up Pond C

In 2009, Duke recognized the need for supplemental water to support operation of the proposed new units during drought conditions and initiated investigations for a proposed new 620-ac reservoir (Make-Up Pond C) in the Lee Nuclear Station site vicinity, within 6 mi of proposed Units 1 and 2. Cultural resources investigations of Make-Up Pond C and associated developments were completed in 2009, 2010, 2011, and 2013 (Brockington 2009b, 2010, 2011, 2013). All methods employed during these investigations were in accordance with Federal and South Carolina guidelines (48 FR 44716; CSCPA 2005; SCDAH 2007a). Scopes of work for the archaeological and architectural surveys and the direct (physical) and indirect (visual) APEs were also reviewed and accepted by the South Carolina SHPO and provided to American Indian Tribes that had previously expressed interest (Duke 2010j).

During the phased investigations of Make-Up Pond C and associated developments (Brockington 2009b, 2010, 2011, 2013), archaeological surveys and test excavations, geomorphological testing, archival investigations, and architectural surveys, were completed for direct (physical) and indirect (visual) APEs by Duke’s primary cultural resources contractor, Brockington and Associates, Inc. A summary of the archaeological sites investigated in direct, physical APEs for Make-Up Pond C is provided in Appendix G.

Surveyors identified ten previously unknown archaeological sites and one historic cemetery in the direct, physical APEs; eight new isolated finds consisting of less than three contemporaneous artifacts were also identified; and one previously recorded historic cemetery was revisited. Historic sites from the late nineteenth to early twentieth centuries dominate the archaeological inventory, including the Service Family Cemetery (38CK142), McKown Family Cemetery, four possible homesites (38CK144, 38CK182, 38CK183, 38CK184), two stills (38CK152, 38CK153), and one road and bridge foundation (38CK148). Two of the identified archaeological sites represented prehistoric occupation during the Middle Archaic period (38CK145, 38CK147) and one resource contained both prehistoric and historic materials (38CK146). Investigators also searched and tested for three previously recorded archaeological sites (38CK31, 38CK32, 38CK58), but they were unable to locate these resources because of significant erosion, modern disturbances since their original recordings, or possibly because the original investigators removed all of the artifacts (Brockington 2010; SCIAA 1981).

In order to assess the potential for buried soils and cultural horizons in the alluvial deposits along the London Creek drainage, which will be inundated by Make-Up Pond C, a program of deep backhoe test excavation was implemented (Brockington 2010). No evidence of buried cultural deposits was recorded in the 39 trenches excavated. The lack of evidence for human occupation along London Creek was attributed to a combination of factors including rugged terrain, frequent flooding, and periodic drought conditions (Brockington 2010).

All of the archaeological resources recorded in direct, physical APEs for Make-Up Pond C were recommended as ineligible for nomination to the National Register and all but two were evaluated as unlikely to warrant additional management consideration (Brockington 2009b, 2010). The historic Service Family Cemetery (38CK142) and McKown Family Cemetery are the exceptions, and while not eligible for nomination to the National Register, these cultural resources are protected from disturbance and desecration under South Carolina State law (SC Code Ann 16-17-600, and SC Code Ann 27-43, summary also found in CSCPA 2005).

The South Carolina SHPO concurred with the eligibility assessments for the archaeological resources located in the Make-Up Pond C direct, physical APEs as well as plans to relocate the Service Family Cemetery (SCDAH 2009b, 2010a, 2011, 2012a). Responses were also received from interested American Indian Tribes. The Eastern Band of Cherokee Indians concurred with the eligibility assessments for archaeological sites (EBCI 2010a, b) and the Seminole Tribe of Florida indicated no objections to the findings (STF 2010).

An architectural survey and background research within the indirect, visual APE of Make-Up Pond C in 2009 and 2010 focused on a zone within 1.25 mi of the proposed reservoir (Brockington 2009b, 2010). Resources identified within this area included 28 individual architectural resources and one possible historic district associated with the Cherokee Falls Mill and Village. Nearly all of the individual resources identified in the area are early twentieth-century residences and associated outbuildings, including 15 houses, 4 barns, and 3 outbuildings. Also near these structures were a middle twentieth-century elementary school, a church and associated cemetery, and one additional cemetery. Only one late nineteenth-century residence and outbuilding were identified. The background research and field investigations completed by Brockington and Associates, Inc. (Brockington 2009b, 2010) demonstrated that all of the individual resources are ineligible for nomination to the National Register, although the two identified cemeteries would merit protection under South Carolina State law. A determination of eligibility was not submitted for the Cherokee Falls Mill and Village pending review of the survey results by the South Carolina SHPO. The South Carolina SHPO concurred with the individual assessments (SCDAH 2009b) and reviewed the Cherokee Mill and Village information to conclude that these resources are also ineligible for National Register nomination (SCDAH 2010a).

Appendix G provides a summary of the historic and cultural resources identified within the direct (physical) and indirect (visual) APEs for Make-Up Pond C.

2.7.3 Historic and Cultural Resources in Transmission Corridors and Offsite Areas

Duke has initiated specific cultural resources investigations of offsite direct (physical) and indirect (visual) APEs over the course of several years, including a 2007 investigation of the railroad corridor (Brockington 2007c), a 2009 investigation of two proposed routes (Routes K and O) for 230-kV and 525-kV transmission lines (ACC 2009), and a 2012 review of proposed transportation improvements (Duke 2012d). All cultural resources survey methods employed during these offsite investigations were in accordance with Federal and South Carolina guidelines (48 FR 44716; CSCPA 2005; SCDAH 2007a). Scopes of work for the archaeological and architectural surveys and the direct and indirect APEs were also reviewed and accepted by the South Carolina SHPO and provided to American Indian Tribes that had previously expressed interest (Duke 2010j).

2.7.3.1 Railroad Corridor

In 2007, Duke contracted with Brockington and Associates, Inc. to conduct cultural resources investigations of the offsite direct, physical APE for reuse of an existing railroad line originally built in the 1970s to support the proposed Cherokee Nuclear Station. Investigators in 2007 did not record any new archaeological sites within the new alignment and did not re-identify any evidence of a previously recorded small prehistoric lithic scatter (38CK38, the “Eroded Site”), reportedly located nearby. This resource was originally recorded in the 1970s during investigations in support of the Cherokee Nuclear Station and evaluated as unlikely to reveal any additional information of importance (SCIAA 1977). Similarly, no new architectural resources were identified within 300-ft-wide corridors on either side of the railroad line defined as the indirect, visual APE.

Background research and surveys confirmed that the existing railroad bed passes directly through a portion of a property listed on the National Register, archaeological site 38CK68 (Ellen Furnace Works), which is significant for its association with early nineteenth-century ironworks that thrived in Cherokee County and were integral to the earliest phases of industrialization in the region (Brockington 2007c). Based on field inspection, the investigators concluded that the portions of 38CK68 located within the railroad line direct, physical APE had been disturbed by previous grading activities associated with the original railroad bed, but observed that this previous disturbance had not altered significant aspects of the site still preserved in the indirect, visual APE (Brockington 2007c). Since the proposed reuse of the existing line through the Ellen Furnace Works property would not require any major alterations to the line or the area through which it passes, no adverse effects were anticipated. The South Carolina SHPO concurred with these findings (SCDAH 2008, 2012a).

Appendix G provides a summary of the resources identified within the direct (physical) and indirect (visual) railroad corridor APEs.

2.7.3.2 Transmission Lines

In 2007, Duke completed a siting study for proposed new offsite transmission lines to connect the Lee Nuclear Station to existing transmission infrastructure in the region (Duke 2007c). This study compared 21 alternative routes within a 283.47 mi^2 study area and selected two preferred routes (Routes K and O) that analyses suggested would pose the least impact to the environment. As part of this siting study, Duke sought input from the interested public, many of whom expressed a general concern about impacts to historic homes, churches, and cemeteries (Duke 2007c: Appendix C). Brockington and Associates, Inc. conducted preliminary records searches with the SCIAA and the South Carolina Department of Archives and History and a "windshield reconnaissance" level survey, traveling existing roads throughout the study area to confirm the continued existence of previously documented historic properties and cultural resources and obtain a general idea of the range of undocumented historic properties and cultural resources in the area (Duke 2007c, 2010q).

One prehistoric archaeological site (38CK52) that had not been evaluated for National Register eligibility was identified within proposed Route K during this initial records search. Results also included six historic buildings within the viewshed of proposed Route O: National Register-eligible Ninety-Nine Islands Dam and Power Plant; the Smith's Ford Farm; and three buildings associated with a farmstead that had not been evaluated for National Register eligibility at that time. Later surveys would confirm this latter property as the National Register-eligible Reid-Walker-Johnson Farm. Preliminary conclusions in the siting study indicated that the historic architectural properties would not be visually affected by the proposed transmission-line route (Duke 2007c).

In 2009, Duke contracted with Archaeological Consultants of the Carolinas, Inc. to conduct intensive archaeological survey and shovel testing within the direct, physical APEs associated with the two preferred routes for the proposed transmission lines (Route K extending 7.94 mi at 325 ft wide and 9.46 mi at 200 ft wide and Route O extending 7.09 mi at 325 ft wide and 6.78 mi at 200 ft wide) and identify previously recorded archaeological sites in the indirect, visual APEs, defined as 0.5-mi-wide corridors on either side of the proposed centerlines of the two transmission lines. Inventory and assessment of architectural properties within these larger indirect, visual APEs were also completed (ACC 2009). Both the South Carolina SHPO and Eastern Band of Cherokee Indians were involved in the development of study plans and APEs and reviewed copies of the resulting reports for this work (Duke 2010j). Archaeological investigations resulted in the identification of 37 new archaeological sites in the direct, physical APEs of the two proposed transmission lines.

Within the direct, physical APE of proposed Route K, 12 new archaeological sites were found (ACC 2009). Prehistoric lithic scatters dominated the inventory (38CK175, 38CK176, 38CK178, 38UN1443, 38UN1445, 38UN1446), followed by historic late nineteenth-, early twentieth-century house sites (38CK174, 38CK177, 38CK181, 38UN1444), and two sites included both prehistoric and historic components (38CK179, 38CK180). Eight new isolated finds, including three prehistoric lithics, four historic ceramic sherds, and two historic glass sherds were also documented (ACC 2009). One previously recorded archaeological site, 38CK52, could not be re-identified in the direct, physical APE, in spite of shovel testing at its reported location (ACC 2009).

Proposed transmission-line Route O passes near the Broad River and archaeological investigations of the direct, physical APE resulted in the documentation of 25 new archaeological sites (ACC 2009). The inventory is dominated by prehistoric lithic scatters (38CK150, 38CK151, 38CK156, 38CK159, 38CK164, 38CK167, 38CK168, 38CK171, 38CK173, 38UN1441), including four with Archaic components (38CK155, 38CK157, 38CK160, 38UN1442), and one with a Mississippian component (38CK149). Seven identified prehistoric lithic scatters also contained late nineteenth-, early twentieth-century historic components (38CK161, 38CK162, 38CK163, 38CK165, 38CK166, 38CK169, 38CK170). Resources from the Historic period included one late nineteenth-, early twentieth-century house site (38CK154) and a possible prospector's pit (38CK158) associated with late nineteenth-, early twentieth-century mining in the area. Finally, one possible grave site (38CK172) was identified (ACC 2009). The seven isolated finds identified in the Route O direct, physical APE included prehistoric flakes and historic domestic artifacts generally thought to be associated with nearby archaeological sites.

The possible grave site (38CK172) identified in the direct, physical APE of Route O is protected by several South Carolina statutes (SC Code Ann 16-17-600, and SC Code Ann 27-43-310, summary also found in CSCPA 2005), and the requirements of the regulations implementing the Native American Graves Protection and Repatriation Act (NAGPRA) may apply if remains are Native American. Investigators evaluated this site as ineligible for nomination to the National Register, but recommended that further investigation or protection may be warranted (ACC 2009). All of the remaining archaeological resources newly identified within the direct, physical APEs for the proposed transmission lines exhibited no preserved cultural features or important deposits and very low potential for future research. As a result, all were recommended as ineligible for nomination to the National Register (ACC 2009). The South Carolina SHPO concurred with these assessments (SCDAH 2009c, 2012a). The Eastern Band of Cherokee Indians also concurred that none of the identified archaeological sites are National Register-eligible, but stressed that the possible burial site (38CK172) is protected under Federal and State burial law (EBCI 2009).

Architectural survey and background research within the indirect, visual APEs of the proposed transmission lines (0.5 mi-wide corridor on either side of the centerlines of Routes K and O) resulted in the identification of 39 resources (ACC 2009). Nine of these are previously recorded resources also located within the indirect APE for onsite activities at the Lee Nuclear Station site: three twentieth-century residences and Ninety-Nine Islands Dam and Power Plant in Route K and four twentieth-century residences and the McKowns Mountain Baptist Church in Route O. Aside from the National Register-eligible Ninety-Nine Islands Dam and Ninety-Nine Island Hydroelectric Project, all of the previously recorded resources collocated in the Lee Nuclear Station site and transmission-line indirect, visual APEs have been assessed by investigators and the South Carolina SHPO as ineligible to the National Register (Brockington 2007a, b; SCDAH 2007b, 2009a, 2012a).

Archival investigations of the indirect, visual APEs for Routes K and O in 2009 (ACC 2009) revealed 7 additional early twentieth-century residences and 1 National Register-eligible middle eighteenth-century farmstead complex (Smith's Ford Farm) and subsequent field investigations resulted in the recording of 20 additional early twentieth-century buildings and one early twentieth-century farmstead complex (Reid-Walker-Johnson Farm). With the exception of Ninety-Nine Islands Dam and Power Plant and the two historic farm complexes, all of the architectural resources identified in Routes K and O have been heavily modified by modern activities and were evaluated as ineligible for the National Register due to lack of research potential and compromised integrity (ACC 2009). The South Carolina SHPO concurred with these recommendations (SCDAH 2009c, 2012a).

Three architectural properties identified in the indirect, visual APE for transmission-line Route O are eligible for National Register nomination: Ninety-Nine Islands Dam and Power Plant; Reid-Walker-Johnson Farm, including the Pleasant Grove Cemetery; and Smith's Ford Farm (ACC 2009). The South Carolina SHPO concurred with these evaluations and requested additional investigation of the viewsheds associated with the two historic farms (SCDAH 2009c). In response, Duke contracted with Pike Electric to complete a visual effects analysis for the transmission line on these properties (Pike Electric 2010). The South Carolina SHPO concurred that these analyses demonstrated that distance, topography, and vegetation will screen both of the National Register-eligible properties from adverse visual impacts (SCDAH 2010b).

Appendix G provides a summary of the historic and cultural resources identified within the direct (physical) and indirect (visual) APEs of the proposed transmission-line routes.

2.7.3.3 Transportation Improvements

In 2012, Duke contracted with Kimley-Horn and Associates, Inc. to complete a cultural resources archive review and limited field inspection of proposed offsite transportation improvements at six key intersections from I-85 east to the Lee Nuclear Station site (Duke 2012d). From west to east, the intersections are as follows:

- I-85 and Shelby Highway
- SC 329 and U.S. Highway 29 (US-29)
- SC 329 and McKowns Mountain Road
- McKowns Mountain Road and Rolling Mill Road
- McKowns Mountain Road and Patrick Road
- McKowns Mountain Road, Sardis Road and Owensby Street.

The archive search revealed five previously recorded archaeological sites evaluated as ineligible for the National Register within the direct APEs for road improvements (38CK29, 28CK48, 38CK49, 38CK132, 38CK133), but no evidence of these resources was observed during field investigations in 2012. The South Carolina SHPO concurred with the assessment that no properties listed in or eligible for listing in the National Register are located in the direct APEs for the transportation improvements (SCDAH 2012b). Documentation of the cultural review has also been provided to Federally recognized American Indian Tribes, including the Catawba Indian Nation, the Eastern Band of Cherokee Indians, and others (Duke 2012d).

Appendix G provides a summary of archaeological sites investigated in proposed offsite transportation improvement APEs.

2.7.4 Consultation

In April 2008, the NRC initiated consultation on the proposed COL by writing to the South Carolina SHPO and the Advisory Council on Historic Preservation. Also in April 2008, the NRC initiated consultations with three Federally recognized American Indian Tribes and four State-recognized Tribal organizations (see Appendix C for a complete list). The Seminole Tribe of Florida was identified by the South Carolina SHPO during the site audit as another Federally recognized tribe with historical ties to Cherokee and York Counties and in June 2008, the NRC also initiated consultation with them. In May 2010, the NRC sent additional invitations to participate in a supplemental scoping process regarding the addition of Make-Up Pond C to the COL application for Lee Nuclear Station Units 1 and 2. At this time, the South Carolina SHPO, Advisory Council on Historic Preservation, and the previously contacted American Indian Tribes and organizations were invited to participate in the expanded environmental review. In 2012, the NRC invited all of these parties to review the draft EIS and the USACE initiated consultation with Duke, the South Carolina SHPO, the Catawba Indian Nation, and the Eastern Band of Cherokee Indians to develop the Lee Nuclear Station site cultural resources management plan and associated MOA. This effort was finalized in 2013, with the USACE, Duke, the South Carolina SHPO, and the Catawba Indian Nation as signatories to the MOA (USACE et al. 2013).

In all of these scoping letters, the NRC provided information about the proposed action; indicated that review under the NHPA would be integrated with the NEPA process in accordance with 36 CFR 800.8; invited participation in identification of and possible decisions regarding historic properties; invited participation in the scoping process; and defined the APE for the new units as the area at the Lee Nuclear Station and its immediate environs that may be impacted by ground-disturbing activities associated with constructing and operating Units 1 and 2. As documented in Appendices C and F, responses to the initial and supplemental scoping letters were received from the South Carolina SHPO, the Catawba Indian Nation, and the Eastern Band of Cherokee Indians indicating a willingness to continue to work with the NRC and Duke in the ongoing environmental review. The NRC followed up on requests from the Catawba Indian Nation with transmittal of all cultural resources information and survey reports completed to date (see Appendix F) and Duke established an ongoing relationship and exchange of information with the South Carolina SHPO, the Eastern Band of Cherokee Indians, and the Seminole Tribe of Florida. All of these groups continue to express interest in reviewing project information through communications with the NRC, the USACE, or Duke (Duke 2010j) and all were invited by the NRC to review the draft EIS in 2012 (Appendix F).

Throughout the cultural resources investigations and consultation process, the South Carolina SHPO has repeatedly requested that an agreement be developed to "…govern future cultural resources identification and address future work to be done at the plant through the life of the license" (SCDAH 2010c). As an initial step to comply with this request, Duke Energy developed a corporate policy for the protection of cultural resources that provides guidance to minimize impacts to cultural resources during activities at all facilities owned and operated by Duke Energy Corporation and general procedures for handling any inadvertent cultural resources discoveries (Duke 2009j). In 2012, Duke, the USACE, the South Carolina SHPO, and THPOs from the Catawba Indian Nation and the Eastern Band of Cherokee Indians worked together to develop a cultural resources management plan and MOA specifically tailored to proposed Lee Nuclear Station Units 1 and 2 and associated developments. Early in 2013, the plan and associated MOA were finalized with the USACE, Duke, the South Carolina SHPO, and the Catawba Indian Nation as final signatories (USACE et al. 2013).

The NRC has conducted two public scoping meetings associated with the COL application for proposed Lee Nuclear Station Units 1 and 2: one related to the initial application and a second for the later addition of Make-Up Pond C. The initial scoping meeting was held on May 1, 2008, in Gaffney, South Carolina and one commenter expressed some concerns about protection of Cherokee Indian sites along the Broad River (NRC 2008f). On June 17, 2010, the NRC conducted a second scoping meeting to seek comment on the addition of Make-Up Pond C to the environmental review. One individual expressed concerns through the supplemental scoping process regarding the flooding of archaeological sites (Breckheimer 2010). Public feedback obtained through the siting study for new transmission corridors also indicated some local concern for preservation of historic cemeteries and other local cultural resource locations (Duke 2007c). Additional coordination between Duke, Duke's cultural resource contractors, and these interested parties are described and referenced in the following sections.

Traditional Cultural Properties and Historic Cemeteries

Ongoing communications between Duke and American Indian Tribes and Tribal groups with historical, cultural, and/or traditional ties to the Cherokee and York Counties area are summarized in the ER (Duke 2009c), the Make-Up Pond C supplement to the ER (Duke 2009b), and in correspondence records provided by Duke for the review team (Duke 2008f, 2010j). Duke sent letters requesting input on cultural resources of concern to American Indian THPOs and chiefs of Federally recognized Tribes, including the Catawba Indian Nation, Eastern Band of Cherokee Indians, the Eastern Shawnee Tribe of Oklahoma, and the Seminole Tribe of Florida. Duke also sent letters requesting input on cultural resources of concern to four American Indian organizations: the Piedmont American Indian Association/Lower Eastern Cherokee Nation, United South and Eastern Federation of Tribes, Carolina Indian Heritage Association, and Pine Hill Indian Community (Duke 2009c). Responses were received from the Catawba Indian Nation, the Eastern Band of Cherokee Indians, the Eastern Shawnee Tribe of Oklahoma, and the Seminole Tribe of Florida (Duke 2009c, 2010j). THPOs from the Catawba Indian Nation and the Eastern Band of Cherokee Indians have also been involved in the development of the Lee Nuclear Station cultural resources management plan and MOA and the Catawba Indian Nation is a signatory to the final MOA (USACE et al. 2013).

No traditional cultural properties have been identified within any of the defined onsite or offsite direct or indirect APEs during coordination and consultation with interested parties, but several specific requests have been received. The Catawba Indian Nation requested archaeological assessment of future project APEs, notification if human remains or sensitive cultural items were located during project activities (Duke 2009c), and ongoing consultation on any proposed ground-disturbing activities (Catawba 2010). The NRC followed through on this request, providing information and survey reports (Appendix F). The Catawba Indian Nation also participated in consultation on the final cultural resources management plan for the Lee Nuclear Station site and associated MOA along with Duke, the USACE, and the South Carolina SHPO (USACE et al. 2013). The Eastern Shawnee Tribe of Oklahoma declined to participate in any further project coordination or consultation, but requested work stoppage and notification if human remains or sensitive cultural items were uncovered (Duke 2009c). The Eastern Band of Cherokee Indians requested continued participation in the project through review of cultural resources investigations completed for current and future APEs (Duke 2009c) and participated in initial consultation on the cultural resources management plan and associated MOA for the

Lee Nuclear Station site and offsite developments. In 2008, the South Carolina SHPO recommended initiation of coordination with the Seminole Tribe of Florida and in response to the resulting invitation from Duke, they requested continued involvement through review of cultural resources survey reports (STF 2009).

Throughout their interactions with Duke, the interested American Indian Tribes have consistently focused their comments on resource identification and protection as well as stop work and notification requirements in the event of inadvertent cultural resources discoveries. The Eastern Band of Cherokee Indians has specifically identified Federal and State requirements regarding the protection of the possible human burial (38CK172) located within the direct APE of transmission-line Route O (EBCI 2009). However, no specific American traditional cultural properties have been identified and in 2011, the Eastern Band of Cherokee Indians confirmed that no culturally important resources are located within any onsite or offsite direct or indirect APEs associated with the Lee Nuclear Station site (EBCI 2011). The Catawba Indian Nation also confirmed support of Duke's intent to protect important cultural resources by participating in consultation on the cultural resources management plan for the Lee Nuclear Station site and associated developments and signing the associated MOA with Duke, the USACE, and the South Carolina SHPO (USACE et al. 2013).

The results of scoping meetings for proposed Lee Nuclear Station Units 1 and 2 and Make-Up Pond C and questionnaires and public meetings associated with the offsite transmission lines indicate local community concerns regarding impacts to historic buildings and cemeteries, as well as protection of scenic, recreational, American Indian, and archaeological resources in the area (Breckheimer 2010; Duke 2007c; NRC 2008f). Several individuals have formally requested access to historic cemeteries within the Lee Nuclear Station site and have communicated with Duke's cultural resources contractor regarding the Service Family Cemetery in the Make-Up Pond C site (Duke 2010d). However, the local community has shared no specific information regarding specific resources of traditional cultural concern located within the Lee Nuclear Station site and vicinity or any of the offsite APEs (Duke 2007c).

Both direct and indirect APEs associated with the Lee Nuclear Station site, Make-Up Pond C, and offsite transmission lines include historic cemeteries. A possible human burial site is located in the offsite direct APE for transmission-line Route O. These resources are protected by South Carolina statutes (SC Code Ann 16-17-600 and SC Code Ann 27-43, summary also found in CSCPA 2005) and the requirements of the implementing regulations of the NAGPRA (25 U.S.C. 3001) may apply if remains are Native American. Although historic cemeteries are generally not eligible for nomination to the National Register, the historic cemeteries identified at the Lee Nuclear Station site are culturally important to local members of the community and the South Carolina SHPO. Duke and Lee Nuclear Station site cultural resources contractors continue to receive periodic requests for access and information on these resources and the importance of continued public access, careful maintenance, and avoidance or mitigation of direct impacts are emphasized in the Lee Nuclear Station site cultural resources management plan and associated MOA (USACE et al. 2013). Avoidance of direct impacts at the possible human burial site is also addressed in the Lee Nuclear Station cultural resources management plan and associated MOA (USACE et al. 2013), in response to concerns expressed by the Eastern Band of Cherokee Indians (EBCI 2009).

2.8 Geology

A detailed description of the geological, seismological, and geotechnical conditions at the Lee Nuclear Station site is provided in Section 2.5 of the Lee Nuclear Station FSAR (Duke 2013a) as part of the COL application. A summary of the geology at the site is presented in Section 2.6 of the ER (Duke 2009c). A description of the geology at the proposed Make-Up Pond C area is presented in the supplement to the ER (Duke 2009b). The regional and site-specific geologic descriptions provided in Duke's FSAR (Duke 2013a) are based on the results of field and subsurface investigations conducted in the 1970s for the unfinished Cherokee Nuclear Station (Duke Power Company 1974a, b, c) and more recently at the site and proposed location of Make-Up Pond C.

The NRC staff's Safety Evaluation Report (SER), which will be published in the future as a NUREG document, will provide a detailed description of the geologic features of the Lee Nuclear Station site and vicinity and document the NRC staff's independent assessment of the applicant's detailed evaluation and analysis of geological, seismological, and geotechnical data. Groundwater hydrological data are analyzed and discussed in detail in Section 2.3 of this report.

The Lee Nuclear Station and Make-Up Pond C sites lie within the Piedmont physiographic province, which is characterized by gently rolling hills cut by drainages with steeper slopes. Site elevations range from 512 ft above MSL at the edge of the Broad River to about 816 ft above MSL on McKowns Mountain, and the design site grade at the proposed locations for Units 1 and 2 is 593 ft above MSL (Duke 2013a). Previous cut and fill activities for the unfinished Cherokee Nuclear Station removed some hills and filled some drainages.

Topography in the vicinity of the Lee Nuclear Station site is controlled by the variations in the resistance of the bedrock to weathering. Bedrock beneath the site consists of igneous, volcaniclastic, and minor sedimentary rocks of the Battleground Formation that were folded, faulted and metamorphosed into felsic and mafic shists, gneisses, and metasediments (Duke 2009b). Quartzite and metaconglomerate rocks are more resistant to weathering and locally create ridges such as McKowns Mountain. The area has undergone extensive erosion and weathering, creating a surficial zone of residual soil and saprolite (chemically weathered in place rock) consisting of sand, silt, and clay typically 40 to 80 ft thick that grades down through partially weathered rock into solid bedrock (Duke 2013a). At one Make-Up Pond C study borehole near London Creek, residual soil and partially weathered rock was more than 190 ft below ground (Duke 2009b). In undisturbed areas, 2 to 8 ft of soil has developed at the surface, while alluvium occurs along the Broad River and smaller drainages onsite. Two aquifers generally occur in the area; the upper aquifer in the saprolite and the lower aquifer in the fractured, partially weathered and unweathered bedrock. According to the U.S. Environmental Protection Agency Sole Source Aquifer Protection Program, no aquifers have been designated as sole source aquifers in the vicinity of the Lee Nuclear Station site (EPA 2011a).

No evidence of previous subsurface mining activity was found at the Lee Nuclear Station site and Duke owns the mineral rights on the site (Duke 2009c). A number of rock and construction material mines exist in the area around the Lee Nuclear Station site (EPA 2011b). The closest to the site is a dredge mining operation for sand in the Broad River located between the mouth of London Creek and the upstream boundary of the Lee Nuclear Station site. None of the mines are designated as major NPDES facilities (EPA 2011b). Duke has indicated material for Make-Up Pond C's earthen dam will be excavated from the footprint of the pond in areas below the pond's future maximum water level (Duke 2009c).

2.9 Meteorology and Air Quality

The following sections describe the climate and air quality of the Lee Nuclear Station site. Section 2.9.1 describes the climate of the region and the immediate vicinity of the site, Section 2.9.2 describes the air quality of the region, Section 2.9.3 describes atmospheric dispersion at the site and in the surrounding area, and Section 2.9.4 describes the meteorological monitoring program at the site.

2.9.1 Climate

The climatological statistics presented in this section are derived from weather stations located near the Lee Nuclear Station site. An onsite meteorological tower (Tower 2) was also constructed specifically to support the COL application. The closest first-order National Weather Service (NWS) stations to the site are Greenville-Spartanburg, South Carolina (34° 54' N, 82° 13' W; located near Greer, South Carolina) (NCDC 2010a), about 42 mi west-southwest of the site and Charlotte, North Carolina (35° 13' N, 80° 57' W) (NCDC 2010b), about 35 mi east-northeast of the site. In addition, Ninety-Nine Islands NWS cooperative station (35° 03' N, 81° 30' W) is located approximately 1.75 mi north of the site (NCDC 2010c). These stations provide a good indication of the general climate at the site because of their proximity and similarities in topography and vegetation. The Lee Nuclear Station site is located near Ninety-Nine Islands Reservoir and the Broad River. Most of the site is approximately 500 to 660 ft above MSL. The dominant terrain feature at the site is McKowns Mountain, the top of which is 816 ft above MSL. Silver Mine Ridge is located approximately 3 mi to the northwest of the site. This ridge is approximately 800 ft above MSL. In other directions, the terrain consists of rolling wooded hills.

The Lee Nuclear Station site is located in the Piedmont region of the Carolinas, which is characterized by a humid, subtropical climate with short, cool winters and long, humid summers. Air masses may approach the region from any direction, but the Appalachian Mountains protect most of the region from cold wintertime air masses (NCDC 2010a, b). Average maximum temperatures at Ninety-Nine Islands NWS cooperative station range from about 88°F in July to 51°F in January, while average minimum temperatures range from about 66°F in July to 27°F in January (SERCC 2010a). Monthly average wind speeds at Greenville-Spartanburg are nearly constant throughout the year, ranging from about 6 mph in the summer to about 8 mph in the winter and early spring (NCDC 2010a, b). Precipitation occurs throughout the year, but slightly more precipitation tends to occur during the spring and summer. Annual average precipitation amounts at Greenville-Spartanburg, Ninety-Nine Islands, and Charlotte are 50.24, 48.37, and 43.51 in., respectively (NCDC 2010a, SERCC 2010a, NCDC 2010b). Snow generally occurs in the period from December through March, but is usually limited to two or three small snowstorms. The annual mean snowfall for the region is approximately 5 to 6 in. (NCDC 2010a, b).

While the regional climate is generally humid, there is a diurnal cycle to relative humidity; the relative humidity is highest during the early morning hours and lowest in the afternoon. For example, during the month of August in Greenville-Spartanburg, the average relative humidity ranges from 90 percent in the morning to 58 percent in the afternoon (NCDC 2010a). The relative humidity is also higher during the summer than the winter. For example, the average daily relative humidity at Greenville-Spartanburg ranges from a maximum of 76 percent in August to a minimum of 62 percent in April (NCDC 2010a). Fog is most common during the winter months, occurring on approximately 4 days in both December and January (NCDC 2010a, b).

On a larger scale, climate change is a subject of national and international interest. The recent compilation of the state of knowledge in this area (GCRP 2009) has been considered in preparation of this EIS. Projected changes in the climate for the region during the life of the proposed Lee Nuclear Station Units 1 and 2 site include an increase in average temperature of 2 to 4°F, a decrease in precipitation in the spring and summer, and an increase in the frequency of heavy precipitation (GCRP 2009).

Based on the assessments of the Global Climate Research Program and the National Academy of Sciences' National Research Council, the EPA determined that potential changes in climate caused by greenhouse gas (GHG) emissions endanger public health and welfare (74 FR 66496). The EPA indicated that, while ambient concentrations of GHGs do not cause direct adverse health effects (such as respiratory or toxic effects), public health risks and impacts can result indirectly from changes in climate. As a result of the determination by the EPA and the recognition that mitigative actions are necessary to reduce impacts, the review team concludes that the effect of GHG on climate and the environment is already noticeable, but not yet destabilizing. In CLI-09-21, the Commission provided guidance to the NRC staff to consider carbon dioxide and other GHG emissions in its NEPA reviews and directed that it should encompass emissions from constructing and operating a facility as well as from the fuel cycle (NRC 2009b). NRC staff memoranda (NRC 2010d, 2011a) provide additional guidance to NRC staff on consideration of GHGs and carbon dioxide in its environmental reviews. The review team characterized the affected environment and the potential GHG impacts of the proposed action and alternatives in this EIS. Consideration of GHG emissions was treated as an element of the existing air-quality assessment, which is essential in a NEPA analysis. In addition, where it was important to do so, the review team considered the effects of the changing environment during the period of the proposed action on other resource assessments.

2.9.1.1 Wind

This section includes a description of the average winds observed in the region as well as the winds measured at the Lee Nuclear Station site meteorological tower. The regional winds are strongly influenced by local effects, such as ridges and valleys, which act to channel the low-level winds. At Greenville-Spartanburg, the average wind direction is generally from the southwest, except during late summer through fall, when the wind comes from the northeast (NCDC 2010a). At Charlotte, the winds are predominately from the south-southwesterly direction, except during late summer through fall, when wind comes from the north-northeast (NCDC 2010b). In both locations, the average wind speeds range from 6 to 8 mph throughout the year (NCDC 2010a, b).

In contrast, the average wind direction measured at the 10-m level on the Lee Nuclear Station site meteorological tower, from December 2005 through November 2006, was from the northwest at approximately 5 mph (Duke 2009c). The predominant northwesterly wind direction at the Lee Nuclear Station site is further supported by consideration of an additional year (December 2006 to November 2007) of onsite meteorological data (Duke 2011b). Differences in wind direction at the various stations are likely due to the channeling of the winds along the Broad River valley at the Lee Nuclear Station site as well as differences in the local topography. These effects are most pronounced when large-scale weather patterns are weak and the wind speed is relatively low. When only cases with wind speeds greater than 5 mph are considered, the predominant wind directions at the Lee Nuclear Station site are from the southwest and northeast, similar to those at Greenville-Spartanburg (Duke 2008h).

2.9.1.2 Atmospheric Stability

Atmospheric stability is a meteorological parameter that describes the dispersion characteristics of the atmosphere. It can be determined by the difference in temperature between two heights. A seven-category atmospheric stability classification scheme, based on temperature differences over a 100-m vertical interval, is established in Regulatory Guide 1.23, Revision 1 (NRC 2007b). When the temperature decreases rapidly with height, the atmosphere is unstable and atmospheric dispersion is greater. Conversely, when temperature increases with height, the atmosphere is stable and dispersion is more limited.

Measurements taken for 1 year (December 2005 through November 2006) at the 60- and 10-m levels at the Lee Nuclear Station site meteorological tower were used to determine atmospheric stability for the site. On an annual basis, the atmosphere at the Lee Nuclear Station site is stable about 50 percent of the time, neutral about 25 percent of the time, and unstable about 25 percent of the time (Duke 2009c). Consideration of an additional year of data (December 2006 through November 2007) results in a similar atmospheric stability distribution (Duke 2011b) for the composite 2-year period of record. Atmospheric stability varies with season and time of day, with stable conditions occurring more frequently at night and unstable conditions occurring more frequently during the day. Seasonally, spring and summer tend to have more extremely unstable conditions because of increased solar heating occurring at the surface. Autumn and winter months exhibit more extremely stable conditions because of reduced solar heating resulting in greater radiational cooling at the surface at night.

2.9.1.3 Temperature

The temperature measured at 10 m above ground at the Lee Nuclear Station site meteorological tower is considered to be reasonably representative of mean temperature conditions in the area around the site. Temperature data from the tower for December 2005 through the November 2006 time period show the daily average temperature ranged from a low of 32°F in December to 84°F in August. During this 1-year period, the absolute minimum temperature was 20°F, and the absolute maximum temperature was 96°F. Consideration of an additional year (December 2006 through November 2007) of onsite meteorological data results in similar temperature trends (Duke 2011b). Longer-term daily average temperatures range from a low of 39°F in January to a high of 77°F in July at the nearby Ninety-Nine Islands NWS cooperative observing station (SERCC 2010a); extreme temperatures have ranged from a minimum of −4°F in December 1962 and January 1985 to a maximum of 106°F in August 1983 (SERCC 2010b).

2.9.1.4 Atmospheric Moisture

The moisture content of the atmosphere can be represented in various ways. The most common are reports of relative humidity, precipitation, and fog. At the Lee Nuclear Station site, the atmospheric humidity is represented using the relative humidity measured 10 m above the ground.

In general, the Piedmont region of the Carolinas experiences high relative humidity throughout much of the year. At Greenville-Spartanburg and Charlotte, the 6-hour average relative humidity is always greater than 50 percent. The highest humidity measurements occur in the early morning hours and are above 80 percent during the months of May through November (NCDC 2010a, b). Humidity at the Lee Nuclear Station site tends to be higher due to the proximity of the Broad River and Ninety-Nine Islands Reservoir. On a diurnal basis, relative humidity levels at the Lee Nuclear Station site (based on measurements between December

2005 and November 2006) appear to be highest during the early morning hours of the summer months (Duke 2009c). This is similar to long-term conditions observed at the two closest first-order NWS stations.

Annual average precipitation amounts at Greenville-Spartanburg, Ninety-Nine Islands, and Charlotte are 50.24, 48.37, and 43.51, respectively (NCDC 2010a, SERCC 2010a, NCDC 2010b). In general, precipitation amounts are fairly evenly distributed throughout the year; however, autumn months tend to be slightly drier. South Carolina has been subject to a number of recent droughts, most notably the periods of 1998 through 2002 (SERCC 2010c) and 2007 through 2008. The precipitation recorded at the Lee Nuclear Station site from December 2005 through November 2006 was 39.72 in. (Duke 2009c) and is comparable to 42.28 in. at Greenville-Spartanburg (NCDC 2010a) over the same period. The 2-year average from December 2005 through November 2007 is 32.70 in. (Duke 2011b) and reflects the more recent dry period.

2.9.1.5 Severe Weather

The Lee Nuclear Station site can experience severe weather in the form of hurricanes, tropical storms, thunderstorms, tornadoes, hail, snow, and ice. Tropical cyclones (e.g., hurricanes, tropical storms, tropical depressions) weaken quickly after they pass over the coast, so regional flooding from excessive rainfall is a larger concern than damaging winds at the Lee Nuclear Station site. The heaviest 1-day rainfall recorded at the nearby Ninety-Nine Islands NWS cooperative station for the period of 1949 to 2005 was 7.16 in. on August 17, 1985 (SERCC 2010b). This rain was associated with Hurricane Danny, which was classified as a tropical depression when it passed through the area (NOAA 2010).

Tornadoes are rare in Cherokee County. A total of 15 tornadoes have been reported within Cherokee County during the period of 1950 to 2010 (NCDC 2010d). Approximately 50 percent of the tornadoes occurred in the months of March through May. Of all the tornadoes observed in Cherokee County, only the May 5, 1989, tornado had a magnitude of F4 (wind speeds ranging from 207 to 260 mph) on the original Fujita scale. Statistical methods (Thom 1963) can be used to compute the probability of the occurrence of a tornado. Given a total path area of 3.57 mi^2 for the 15 tornadoes recorded in Cherokee County, an average of 0.26 tornadoes per year, and that Cherokee County has an area of 392.7 mi^2, the probability of a tornado striking any point in the county is 1.6×10^{-4}/yr. This value is consistent with results obtained from NUREG/CR-4461 (Ramsdell and Rishel 2007), which yields a probability of 3.7×10^{-4}/year.

Thunderstorms are common throughout the Piedmont region of North and South Carolina and occur on approximately 40 days per year. The majority of reported thunderstorms occur during May through July (NCDC 2010a, b). Hail occurred, on average, about four times per year in Cherokee County during the period 1993 to 2010. Damaging hail is less frequent, and damage from hail was reported in only 3 of the last 17 years (NCDC 2010e). The average annual snowfall for the region is approximately 5 to 6 in. Instances of large snowfall amounts are not common; the greatest 24-hour snowfall total was around 12 in. (NCDC 2010a, b).

South Carolina is subject to hurricanes, which have sustained wind speeds greater than 74 mph (119 km/hr); tropical storms, which have wind speeds between 39 and 73 mph (63 and 118 km/hr), respectively; and tropical depressions, which have wind speeds less than 39 mph (63 km/hr). A total of 19 tropical storms and tropical depressions have passed within 50 statute miles of the Lee Nuclear Station site during the period of 1859 to 2009. Hurricane Hugo was the only hurricane to pass within 50 statute miles during the period of record. At the time it passed the site, Hurricane Hugo was a category 2 hurricane on the Saffir-Simpson Hurricane

Scale, with a sustained wind speed between 96 and 110 mph (NOAA 2010).

2.9.2 Air Quality

The Lee Nuclear Station site is in Cherokee County, South Carolina, which is located within the Greenville-Spartanburg Intrastate Air Quality Control Region (AQCR); this AQCR also includes the counties of Anderson, Greenville, Oconee, Pickens, and Spartanburg (40 CFR 81.106). Within this AQCR, the counties of Anderson, Greenville, and Spartanburg are classified as maintenance areas for the 8-hour ozone National Ambient Air Quality Standard (NAAQS). All other counties, including Cherokee County, are designated as being in attainment or unclassified for NAAQS criteria pollutants (40 CFR 81.341).

Prior to 1992, Cherokee County had been designated as a marginal ozone nonattainment area for the 1-hour ozone standard; however, this standard was revoked on June 15, 2005 (40 CFR 81.341). As part of the anti-backsliding provisions in the final rule to implement the 8-hour ozone standard, a 40 CFR 52 (Clean Air Act) Section 110(a)(1) maintenance plan was prepared for Cherokee County and submitted to the EPA in 2007 (SCDHEC 2007a); it was finalized in 2010 (75 FR 3870). The purpose of the plan is to ensure that Cherokee County remains in compliance with ozone standards. However, this maintenance plan does not carry any conformity obligations (EPA 2010a).

SCDHEC operates a statewide air-monitoring network composed of 34 sites that monitor various criteria pollutants (SCDHEC 2012b). The closest monitoring stations to the Lee Nuclear Station are the Cowpens National Battlefield in Cherokee County and York in York County. Additional nearby stations are located in the Spartanburg and Greenville areas, and include the North Spartanburg Fire Station site. Monitoring results at all locations indicate that as of 2012, there were no days on which the NAAQS criteria for sulfur dioxide, nitrogen dioxide, carbon monoxide, or particulate matter were exceeded (SCDHEC 2012b). In 2008, the NAAQS 8-hour ozone standard was reduced from 0.080 to 0.075 parts per million (ppm) (73 FR 16436). Monitoring results from 2011 and 2012 indicate that all locations were within the standard (SCDHEC 2012c).

Six areas in North and South Carolina are designated in 40 CFR 81.422 and 40 CFR 81.426, respectively, as mandatory Class I Federal areas in which visibility is an important value. The nearest Class I area is the Linville Gorge Wilderness Area, which is more than 50 mi north-northwest of the Lee Nuclear Station site.

2.9.3 Atmospheric Dispersion

Atmospheric dispersion factors, referred to as χ/Q values, are used to evaluate the potential consequences of routine and accidental releases at the Lee Nuclear Station site. Duke used 2 years (December 2005 through November 2007) of onsite meteorological data to calculate χ/Q values (Duke 2013c). The meteorological data were provided to the NRC staff so that independent, confirmatory estimates could be made. Because accurate meteorological measurements are necessary for calculating site-specific χ/Qs, the NRC staff viewed the Lee Nuclear Station site meteorological tower and instrumentation, reviewed the meteorological monitoring program information, and evaluated the program's data. Based on this information, the NRC staff concludes that the meteorological program provides data that represent the affected environment as required by 10 CFR 100.20. The data therefore provide an acceptable basis for making estimates of atmospheric dispersion for the evaluation of the consequences of long-term routine and short-term accidental releases required by 10 CFR 50.34; 10 CFR Part 50, Appendix I; and 10 CFR 52.79. These estimates are provided in the following sections.

2.9.3.1 Long-Term Dispersion Estimates

Long-term, routine release atmospheric dispersion (χ/Q) and atmospheric deposition (D/Q) factors for the Lee Nuclear Station site were calculated using the XOQDOQ dispersion program (Sagendorf et al. 1982). XOQDOQ, which implements Regulatory Guide 1.111 (NRC 1977a), is a straight-line Gaussian plume model that calculates annual average values for the 16 cardinal directions at the exclusion area boundary (EAB), the low population zone (LPZ), discrete distances and ranges of distances extending out to 50 mi, and other receptor locations (e.g., the site boundary, nearest milk cow, milk goat, garden, meat animal, and residence). Two years of onsite meteorological data (December 2005 through November 2007), which include estimates of atmospheric stability and measurements at the 10-m level for wind speed and wind direction, were used in the calculation. In addition, the XOQDOQ model analysis was performed assuming a ground-level release and accounted for enhanced dispersion due to building wake effects.

The maximum annual average relative atmospheric dispersion and deposition factors are reported in Table 2-29. The relative atmospheric dispersion factors, accounting for deposition (i.e., depleted) are also provided. Values listed in Table 2-29 are used in Section 5.9 of this EIS to estimate radiological health impacts of normal operations.

Table 2-29. Maximum Annual Average Atmospheric Dispersion and Deposition Factors for Evaluation of Normal Effluent Releases for Receptors of Interest (Duke 2013a, 2013g)

Receptor	Downwind Sector	Distance (mi)	No Decay Undepleted χ/Q (s/m^3)	No Decay Depleted χ/Q (s/m^3)	D/Q (1/m^2)
Site boundary[(a)]	NW, Unit 1	0.27	1.5×10^{-5}	1.3×10^{-5}	2.9×10^{-8}
EAB	SE, Unit 2	0.81	6.3×10^{-6}	5.6×10^{-6}	1.3×10^{-8}
Residence	SE	0.99	4.6×10^{-6}	4.0×10^{-6}	9.4×10^{-9}
Meat animal	SE	1.65	2.2×10^{-6}	1.8×10^{-6}	3.9×10^{-9}
Vegetable garden	SSE	1.00	2.4×10^{-6}	2.1×10^{-6}	4.3×10^{-9}
Milk cow	SE	1.65	2.2×10^{-6}	1.8×10^{-6}	3.9×10^{-9}
Milk goat	SSW	1.05	1.6×10^{-6}	1.4×10^{-6}	3.6×10^{-9}

(a) In response to an NRC staff request for additional information (RAI), Duke reevaluated its air dispersion modeling and revised their calculations (Duke 2013g). At the time of publication of this final EIS, the NRC staff review of the applicant's RAI response to assure that the applicant meets all applicable regulatory requirements is ongoing. NRC's evaluation of Duke's response will be addressed in the NRC's Final Safety Evaluation Report and any changes to the COL application that are deemed necessary will be incorporated into the applicant's FSAR.

2.9.3.2 Short-Term Dispersion Estimates

Short-term, accidental release atmospheric dispersion (χ/Q) factors for the Lee Nuclear Station site were calculated using the PAVAN dispersion program (Bander 1982). PAVAN, which implements Regulatory Guide 1.145 (NRC 1983), is a straight-line Gaussian plume model that calculates short-term average χ/Q values at the EAB and LPZ as a function of 16 cardinal directions for various time periods. A joint frequency distribution of wind speed and wind direction by atmospheric stability classes was created from 2 years (December 2005 through November 2007) of onsite hourly data. For the purpose of estimating dose to the environment, 50th percentile χ/Q values are used and represent typical meteorological conditions that can be expected in the site vicinity (NRC 1976a). Based on the AP1000 reactor design, the release point is considered to be near ground level.

Table 2-30 provides a summary of the Lee Nuclear Station site χ/Q values for the 0- to 2-hour period at the EAB and the 0- to 8-hour, 8- to 24-hour, 1- to 4-day, and 4- to 30-day periods at the LPZ (Duke 2013c). Values listed in Table 2-30 are used in Section 5.11 of this EIS to estimate dose for design-basis accidents (DBAs).

Table 2-30. Short-Term Atmospheric Dispersion Factors for Lee Nuclear Station Site DBA Calculations

Time Period	Boundary	χ/Q (s/m^3)
0 to 2 hours	EAB	8.30×10^{-5}
0 to 8 hours	LPZ	8.80×10^{-6}
8 to 24 hours	LPZ	7.51×10^{-6}
1 to 4 days	LPZ	5.33×10^{-6}
4 to 30 days	LPZ	3.25×10^{-6}

Source: Duke 2013c

2.9.4 Meteorological Monitoring

Meteorological monitoring at the Lee Nuclear Station site originally began in the 1970s, when the site was first considered for nuclear reactors. Lee Nuclear Station site Tower 2 was constructed and commenced operation on December 1, 2005 for the purpose of meeting current licensing activities; this tower is discussed in the applicant's ER and in more detail below. In addition, a third meteorological tower has been installed to meet the operational needs of a licensed plant (Duke 2009c).

Tower 2 is a 60-m meteorological tower, instrumented with wind and temperature sensors at the 10- and 60-m levels. Dewpoint temperature is also measured at the 10-m level. In addition, temperature, pressure, incoming solar radiation, and precipitation are measured near ground level (Duke 2009c). Tower 2 became operational on December 1, 2005, to provide meteorological information needed for siting purposes. The instrumentation on this tower meets the recommendations described in Revision 1 of Regulatory Guide 1.23 for meteorological monitoring programs for nuclear power plants (NRC 2007b).

Data acquired by the meteorological monitoring system are stored by the local data logger and are available for remote access. Each sensor is sampled at least once every second; these data are used to compute 1-minute, 15-minute, and 1-hour averages (Duke 2013c). Data are collected by Duke's Ambient Monitoring Group on a daily basis for preliminary analysis. Onsite checks are performed monthly to verify proper operation of the system. Site technicians also complete a review of all data collected during the previous month. Additional review is conducted by Duke's Ambient Monitoring Group (Duke 2009c).

The meteorological equipment is kept properly calibrated and in good working order by trained staff members. All equipment is calibrated or replaced at least every 6 months. The methods for maintaining a calibrated set of instruments and data-collection system include field checks, field calibration, and/or replacement by laboratory-calibrated components. More frequent calibration can be conducted if required (Duke 2009c).

2.10 Nonradiological Environment

This section describes aspects of the environment at the Lee Nuclear Station site and within the vicinity of the site associated with nonradiological human health impacts. It provides the basis for evaluation of impacts on human health from building and operation of the proposed Lee Nuclear Station Units 1 and 2. Building activities have the potential to affect public and occupational health, create impacts from noise, and affect the health of the public and workers by transportation of construction materials and personnel to the Lee Nuclear Station site. Operation of the proposed Lee Nuclear Station Units 1 and 2 has the potential to affect the public and workers at the Lee Nuclear Station site from operation of the cooling system, noise generated by operations, electromagnetic fields (EMFs) generated by transmission systems, and transportation of operations and outage workers to and from the Lee Nuclear Station site.

2.10.1 Public and Occupational Health

This section describes public and occupational health at the Lee Nuclear Station site and vicinity associated with air quality, occupational injuries, and etiological (i.e., disease-causing) agents.

2.10.1.1 Air Quality

Public and occupational health can be affected by changes in air quality from activities that contribute to fugitive dust, vehicle and equipment exhaust emissions, and automobile exhaust from commuter traffic (NRC 2013a). Air quality for Cherokee County is discussed in Section 2.9.2. Fugitive dust and other particulate matter (including particulate matter smaller than 10 µm and particulate matter smaller than 2.5 µm) can be released into the atmosphere during any site excavations and while grading is being conducted. Most activities that generate fugitive dust are short in duration, cover a small area, and can be controlled by watering unpaved roads, stabilizing construction roads and spoil piles, and other best management practices described in Section 4.4.1.6 (Duke 2009c). Mitigation measures to minimize and control fugitive dust are required for compliance with all Federal, State, and local regulations that govern such activities (NRC 2013a; Duke 2009c).

Exhaust emissions during normal plant operations associated with onsite vehicles and equipment as well as from commuter traffic can affect air quality and human health. Supporting equipment (e.g., diesel generators, fire-prevention pump engines), and other nonradiological emission-generating sources (e.g., storage tanks) or activities are not expected to be a significant source of criteria pollutant emissions. Diesel generators and supporting equipment would be in place for emergency use only but would be started regularly to confirm that the systems are operational. Emissions from nonradiological sources of air pollution are permitted by the SCDHEC.

2.10.1.2 Occupational Injuries

In general, occupational health risks to workers and onsite personnel engaged in activities such as building, maintenance, testing, excavation, and modifications are dominated by occupational injuries (e.g., falls, electric shock, asphyxiation) or occupational illnesses. Historically, actual injury and illness rates for building and operating utility systems have been lower than the average U.S. industrial rates (BLS 2011b). The U.S. Bureau of Labor Statistics (BLS) provides reports that account for occupational injuries and illnesses as total recordable cases, including cases that result in loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid. The State of South Carolina also tracks the annual incidence rates of injuries and illnesses for utility system construction. These records of statistics are used to estimate the likely number of occupational injuries and illnesses for building and operating the proposed units. According to the BLS, rates for occupational injuries and illnesses in years 2001 to 2009 ranged from 3.8 to 7.8 for the United States and 2.8 to 5.7 for South Carolina for heavy and civil engineering construction and utility system construction, respectively (BLS 2011b, c). For the same years, rates for utilities and electric power generation, transmission, and distribution ranged from 3.3 to 5.7 for the United States and 1.3 to 3.2 for South Carolina (BLS 2011b, c).

2.10.1.3 Etiological Agents

Public and occupational health can be compromised by activities at the Lee Nuclear Station site that encourage the growth of etiological agents. Thermal discharges from proposed Lee Nuclear Station Units 1 and 2 into the circulating-water system and the Broad River (Duke 2009c) have the potential to increase the growth of thermophilic microorganisms. The types of organisms of concern for public and occupational health include enteric pathogens (e.g., *Legionella* spp.) and free-living amoeba (e.g., *Naegleria fowleri* and *Acanthamoeba* spp.). These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels.

A review of the outbreaks of human waterborne diseases in South Carolina indicates that the incidence of most of these diseases is not common. Available data assembled by the U.S. Centers for Disease Control and Prevention (CDC) for the years 1996 to 2007 (CDC 1997, 1998, 1999, 2001, 2002, 2003, 2004, 2005, 2006, 2007) report only two occurrences of waterborne outbreaks of disease from recreational water in South Carolina. From 1989 to 2000, the CDC surveillance system for waterborne-disease outbreaks documented 24 fatal cases of primary amebic meningoencephalitis (a disease caused by *Naegleria fowleri*) in the United States, most occurring in southern states during July and September (CDC 2008). Outbreaks of Legionellosis, Salmonellosis, or Shigellosis that occurred in South Carolina were within the range of national trends in terms of cases per 100,000 population or total cases per year, and the outbreaks were associated with pools, spas, or lakes (CDC 1997, 1998, 1999, 2001, 2002, 2003, 2004, 2005, 2006, 2007).

Epidemiological reports from South Carolina indicate a very low risk of outbreaks from thermophilic microorganisms associated with recreational water (CDC 2006). In the *South Carolina Annual Report on Reportable Conditions* for the years 2007 and 2008, the SCDHEC reported 28 cases of Legionellosis, 11 cases of Salmonellosis, and 1 case of Shigellosis in Cherokee County (SCDHEC 2010b).

No SCDHEC water-quality monitoring stations are located in the vicinity of the proposed discharge for the Lee Nuclear Station. The closest USGS water-quality monitoring station to Lee Nuclear Station is USGS 02153551, which is located on the Broad River just below Ninety-Nine Islands Reservoir. A discussion of water quality in the Broad River is included in Section 2.3.3.1. The main recreational activities associated with the Broad River are fishing, boating, and occasional swimming (Duke 2009c). The closest recreation area to the proposed site is Ninety-Nine Islands Reservoir, directly east-adjacent to the site and where the proposed Lee Nuclear Station will discharge thermal effluent, upstream of the dam (Duke 2009c). Ninety-Nine Islands Reservoir features the Cherokee Ford Recreation Area, upstream of the Lee Nuclear Station site on the west bank of the reservoir near Goat Island; Pick Hill boat access, just north of the dam on the east bank of reservoir; and another access area just south of the dam on the east bank that has a canoe portage, a tailrace fishing area, and a boat ramp (Duke 2009c).

2.10.2 Noise

Existing sources of noise at the Lee Nuclear Station site, other than natural sources, are limited to the occasional use of maintenance equipment, traffic entering and exiting the site, and security activities (Duke 2011b). In the summer of 2006, an ambient noise survey was conducted on the Lee Nuclear Station site that identified offsite noise levels at several sensitive receptor locations in the ranges of 28 and 83 dBA for daytime levels and between 36 and 75 dBA for nighttime levels (Duke 2011b). For context, the sound intensity of a quiet office is 50 dBA, normal conversation is 60 dBA, busy traffic is 70 dBA, and a noisy office with machines or an average factory is 80 dBA (Tipler 1982).

Regulations governing noise associated with the activities at the Lee Nuclear Station site are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910, *Occupational Health and Safety Standards*, and 40 CFR Part 204, *Noise Emission Standards from Construction Equipment*. The regulations in 29 CFR Part 1910 deal with noise exposure in the construction environment, and the regulations in 40 CFR Part 204 generally govern the noise levels of compressors.

2.10.3 Transportation

According to the ER (Duke 2009c), the Lee Nuclear Station site is served by a transportation network of Federal and State highways, one primary freight rail service, and two primary commercial passenger airports. Because of downstream dams, the Lee Nuclear Station site cannot be accessed by barge. Within Cherokee and York Counties, there are two interstate highways and four Federal highways. I-85 runs northeast through northern Cherokee County, entering the county north of Cowpens, South Carolina, passing on the northern boundaries of Gaffney and Blacksburg, South Carolina, then crossing into North Carolina east of Grover, North Carolina. I-77 runs north to south through eastern York County, entering the county south of Rock Hill, South Carolina, passing through eastern portions of Rock Hill, South Carolina, and western portions of Fort Mill, South Carolina, and then crossing into North Carolina on the south side of Charlotte, North Carolina. US-221 passes through the extreme northwest corner of Cherokee County, South Carolina. US-29 parallels I-85 through Cherokee County, passing through downtown Gaffney and Blacksburg, South Carolina. US-321 runs north to south through central York County, passing through McConnells, York, and Clover, South Carolina. US-21 runs north to south through eastern York County, passing through Lesslie, Rock Hill, and Fort Mill, South Carolina. Numerous state routes pass through the counties, providing rural areas access to the urban areas. Access to the site is only available on McKowns Mountain Road on the south side of the site. The majority of proposed Lee Nuclear Station Units 1 and 2 construction and operations workers are expected to reside in Cherokee and York Counties.

Cherokee and York Counties consist of both urban and rural roadways. Vehicle volume on roads, obtained from estimated Annual Average Daily Traffic (AADT) data from the South Carolina Department of Transportation, reflects the urban and rural character of the counties. AADT counts for 2006 indicate that approximately 7000 vehicles traveled on US-29 between SC 329 and SC 5 and a maximum of approximately 5600 vehicles travel on SC 5 between US-29 and SC 55. Approximately 5000 vehicles also travel along SC 105 between SC 211 and SC 18. Approximately 1600 vehicles travel on SC 329 between SC 105 and US-29, and approximately 425 vehicles travel on SC 97 between SC 5 and the York County line. Approximately 950 vehicles travel McKowns Mountain Road between SC 105 and the end of the road (near the Broad River). McKowns Mountain Road is also known as Cherokee County Highway 13 and County Road 13.

According to the South Carolina Department of Transportation, no road modifications near the Lee Nuclear Station site are planned; however, several road construction projects are planned in Cherokee County between 2011 and 2016. Planned projects include installation of a bridge over Furnace Creek on S-41, an emergency bridge replacement on SC 150 at I-85, and replacement of a bridge 2 mi east of Gaffney on US-29. SC 329 and McKowns Mountain Road were upgraded in the 1970s to handle anticipated truck traffic for construction of the Cherokee Nuclear Station.

2.10.4 Electromagnetic Fields

Transmission lines generate both electric and magnetic fields, referred to collectively as EMFs. Public and worker health can be compromised by acute and chronic exposure to EMFs from power transmission systems, including switching stations (or substations) onsite and transmission lines connecting the plant to the regional electrical distribution grid. Transmission lines operate at a frequency of 60 Hz (60 cycles per second), which is considered to be extremely low frequency (ELF). In comparison, television transmitters have frequencies of 55 to 890 MHz and microwaves have frequencies of 1000 MHz and greater (NRC 1996).

Electric shock resulting from direct access to energized conductors or from induced charges in metallic structures is an example of an acute effect from EMFs associated with transmission lines (NRC 1996). Objects near transmission lines can become electrically charged by close proximity to the electric field of the line. An induced current can be generated in such cases, where the current can flow from the line through the object into the ground. Capacitive charges can occur in objects that are in the electric field of a line, storing the electric charge, but isolated from the ground. A person standing on the ground can receive an electric shock from coming into contact with such an object because of the sudden discharge of the capacitive charge through the person's body to the ground. Such acute effects are controlled and minimized by conformance with National Electrical Safety Code (IEEE 2011) criteria that limit the induced current from electrostatic effects to 5 mA.

Long-term or chronic exposure to power transmission lines has been studied for a number of years. These health effects were evaluated in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants*, *Main Report* (GEIS) (NRC 1996) for nuclear power in the United States and are discussed in the ER (Duke 2009c). The GEIS (NRC 1996) reviewed human health and EMF and concluded:

> The chronic effects of electromagnetic fields (EMFs) associated with nuclear plants and associated transmission lines are uncertain. Studies of 60-Hz EMFs have not uncovered consistent evidence linking harmful effects with field exposures. EMFs are unlike other agents that have a toxic effect (e.g., toxic chemicals and ionizing radiation) in that dramatic acute effects cannot be forced and longer-term effects, if real, are subtle. Because the state of the science is currently inadequate, no generic conclusion on human health impacts is possible.

2.11 Radiological Environment

No operations involving radioactive materials have occurred at the Lee Nuclear Station site; the Cherokee Nuclear Station reactors were left unfinished. Two main sources of natural background radiation exist: cosmic radiation, produced by collisions of high-energy particles in the upper atmosphere, and naturally occurring terrestrial radionuclides in rocks and soils. The cosmic ray background varies with geomagnetic latitude and elevation; the cosmic ray dose rate in North and South Carolina is about 25 mrem/yr. The dose rate from uranium, thorium, potassium, and related natural radionuclides depends on the underlying geology. Two main regions with differing natural terrestrial radionuclide dose rates are found in North and South Carolina: the Atlantic Coastal Plain and the Piedmont (National Academy of Sciences 1980). The Atlantic Coastal Plain rises from the sandy beaches of the Atlantic coast to about 300 ft elevation (called the fall line), and the Piedmont rises from about 300 ft to a high of about 1500 ft where it meets the Blue Ridge. Terrestrial dose rates in the Atlantic Coastal Plain average between 15 and 35 mrem/yr, and terrestrial dose rates in the Piedmont average between 35 and 75 mrem/yr. When combined with the cosmic ray contribution, direct natural radiation in North and South Carolina ranges between 40 to 60 mrem/yr in the coastal plain and 60 to 100 mrem/yr in the Piedmont. Therefore, the naturally occurring background radiation dose rates at the Lee Nuclear Station site should be in the anticipated range of 60 to 100 mrem/yr, which is consistent with the United States average of about 100 mrem/yr from direct radiation (NCRP 2009).

Two years prior to the operation of Lee Nuclear Station Unit 1, preoperational radiological monitoring would be used to establish the baseline for local radiological environmental conditions along the pathways of exposure discussed in Section 5.9.1 (Duke 2009c).

2.12 Related Federal Projects and Consultation

The staff reviewed the possibility that activities of other Federal agencies might impact the issuance of COLs to Duke. Any such activities could result in cumulative environmental impacts and the possible need for another Federal agency to become a cooperating agency for preparation of the EIS (10 CFR 51.10(b)(2)). As discussed in Chapter 1, the USACE is a cooperating agency and the FERC is a participating agency in the preparation of this EIS.

Ninety-Nine Islands Dam and Ninety-Nine Islands Hydroelectric Project are located on the Broad River just downstream of the Lee Nuclear Station site. The 18-MW hydroelectric project is licensed to operate by the FERC (FERC 2011c). The Ninety-Nine Islands Reservoir is part of the hydroelectric project (FERC No. 2331) and is under the jurisdiction of the FERC. In the summer of 2013, Duke intends to submit to the FERC an application for Non-Project Use of Project Lands and Water. This application would cover four actions in the Ninety-Nine Islands Reservoir related to the proposed Lee Nuclear Station: (1) construction of the river intake structure in the reservoir, (2) construction of the discharge pipe in the reservoir, (3) withdrawal of water from the reservoir, and (4) discharge of water to the reservoir. Duke has initiated early consultation with the FERC regarding the proposed actions.

Federal lands within a 50-mi radius of the Lee Nuclear Station site include Kings Mountain National Military Park, Cowpens National Battlefield, and Sumter National Forest. The Sumter National Forest is managed by the U.S. Department of Agriculture. Several state parks exist within the 50-mi radius, including Kings Mountain State Park in South Carolina and Crowders Mountain State Park in North Carolina. The SCDNR has classified the Broad River south of

Ninety-Nine Islands Dam to the confluence with the Pacolet River as a State Scenic River. The Tribal reservation for the Federally recognized Catawba Indian Nation is approximately 31 mi east-southeast of the Lee Nuclear Station site. Under Section 102(2)(C) of NEPA, the NRC is required to "consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved." During the course of preparing this EIS, the NRC consulted with various Federal, State, and local agencies and Tribal contacts. Appendix F provides a list of consultation correspondence.

3.0 Site Layout and Plant Description

This chapter describes the key plant characteristics that are used in the assessment of the environmental impacts of building and operating the proposed William States Lee III Nuclear Station (Lee Nuclear Station) Units 1 and 2. Units 1 and 2 and supporting buildings would be situated wholly within the 1900-ac Lee Nuclear Station site. Make-Up Pond C, a proposed impoundment to provide supplemental water in case of low flow in the Broad River, would be located northwest of the Lee Nuclear Station site (Figure 3-1). The information for this chapter is drawn from Revision 1 of the environmental report (ER) prepared by Duke Energy Carolinas, LLC (Duke) (Duke 2009c), the Make-Up Pond C supplement to the ER (Duke 2009b), the Final Safety Analysis Report (FSAR) (Duke 2013a), and supplemental documentation provided by Duke (2007c, 2008i, o, 2009k, l, 2010c, d, f, h, k-m, 2011a, e-f, h-i, 2012b, e-k, 2013c, d).

Whereas Chapter 2 of this environmental impact statement (EIS) describes the existing environment of the proposed site and its vicinity, this chapter describes the physical layout of the proposed plant. This chapter also describes the physical activities involved in building and operating the plant. The environmental impacts of building and operating the plant are discussed in Chapters 4 and 5, respectively. This chapter is divided into four sections. Section 3.1 describes the external appearance and layout of the proposed plant. Section 3.2 describes the major plant structures and distinguishes structures that routinely interface with the environment from those that minimally or temporarily interface with the environment. Section 3.3 describes the activities involved in building or installing each of the plant structures. Section 3.4 describes the operational activities of the plant that interface with the environment.

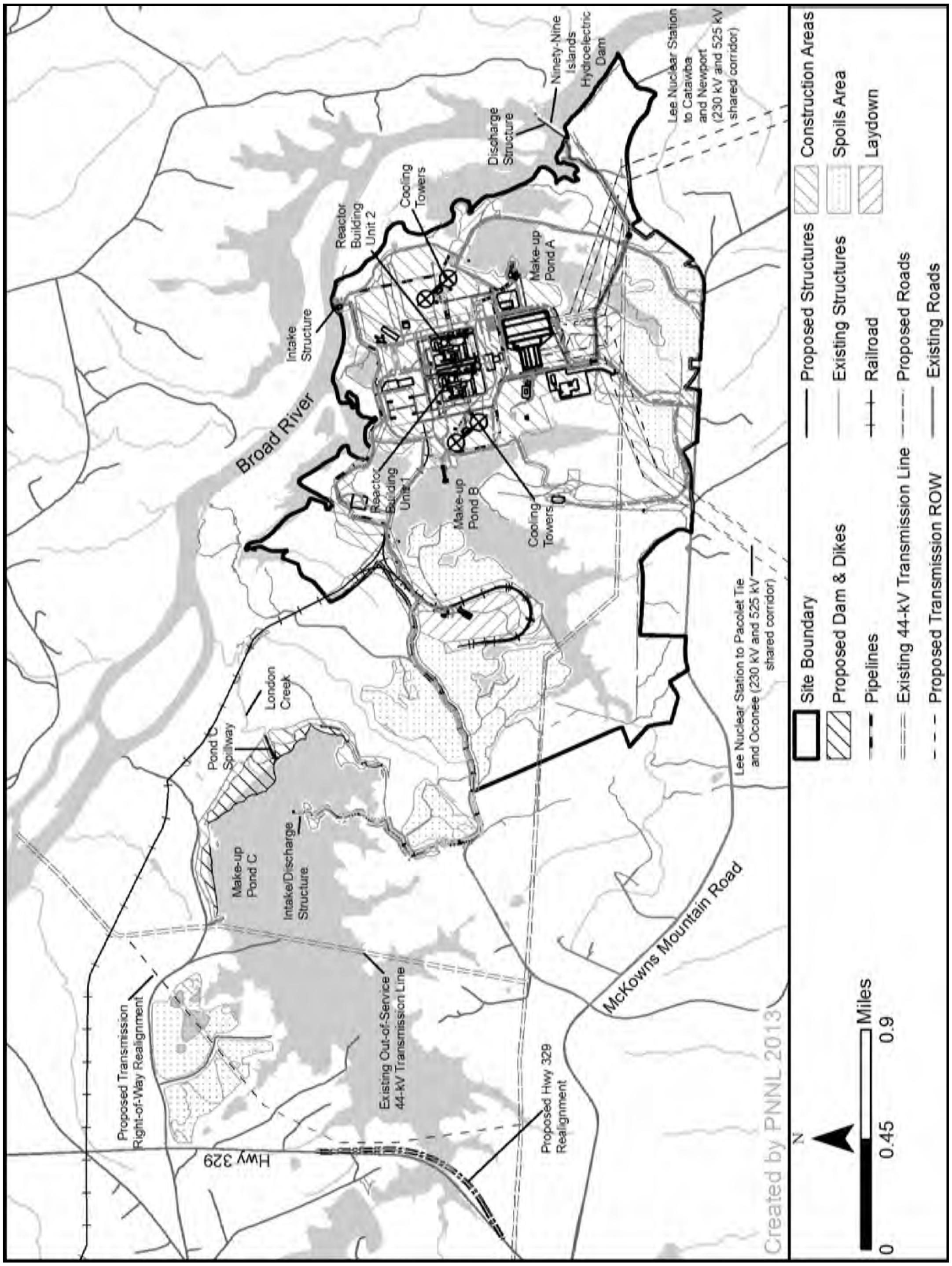

Figure 3-1. Lee Nuclear Station Site and Proposed Make-Up Pond C

3.1 External Appearance and Plant Layout

The proposed Lee Nuclear Station would be located on the site of the unfinished Cherokee Nuclear Station, for which a construction permit was granted to Duke Power Company by the U.S. Nuclear Regulatory Commission (NRC) in 1975 (NRC 1975a). The containment structure of Cherokee Nuclear Station Unit 1 (of three proposed units) was partially complete when construction was halted in 1982; it was demolished in 2007. The proposed Lee Nuclear Station site development is shown in Figure 3-1. The proposed Units 1 and 2 would be located on the 750-ac portion of the site that was previously disturbed by site preparation and building of the unfinished Cherokee Nuclear Station (Duke 2009c). Some of the existing warehouses built before 1982 will be used to support Lee Nuclear Station building activities. An existing basemat[(a)] installed for the unfinished Cherokee Nuclear Station Unit 1 will be used as fill for Lee Nuclear Station Unit 1, which will be installed at a higher elevation (Duke 2009c). All other previously constructed buildings were demolished in 2007 and 2008; other than reuse of some warehouses, all support buildings and facilities for Lee Nuclear Station will be new.

The proposed location of Lee Nuclear Station Units 1 and 2, would have a design site grade of 593 ft above mean sea level (MSL) (Duke 2013a). The containment vessel, shield building, and auxiliary building make up the “nuclear island,” which is one of five principal structures of the standard Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water nuclear power reactor proposed for Lee Nuclear Station Units 1 and 2. The other four principal structures of an AP1000 unit are the turbine building, diesel generator building, radwaste building, and annex building. In a letter dated December 20, 2012, Duke notified the NRC that a slight shift in the location of the proposed Units 1 and 2 was required to manage project construction risks and that the plant grade elevation was being increased by 3 ft (Duke 2012l). The remainder of Chapter 3 Site Layout and Plant Description incorporates the 3-ft increase in site grade and slight shift in the location of Units 1 and 2 (Unit 1 shifts 50 ft east and both units shift 66 ft south).

The footprint areas of the new units are adjacent to each other, with the center of Unit 2 situated 800 ft east and slightly north of the center of Unit 1. Each new reactor unit would be supported by two mechanical draft cooling towers for the circulating-water system (CWS), each 85 ft high and 360 ft in diameter. The proposed location for the Unit 1 cooling towers is approximately 1000 ft west of Unit 1; the proposed location for the Unit 2 cooling towers is approximately 1000 ft east of Unit 2. The CWS cooling-tower bases would be at an elevation 588 ft above MSL (Duke 2012g, 2013a). Each unit also has one mechanical draft cooling tower for the

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(a) Basemat is a commonly used type of foundation for five principal building structures at nuclear power plants: reactor building, turbine building, annex building, diesel generator foundation, and radwaste building. In general, a basemat is a flat, thick slab that supports the specific building. During construction, special consideration is given to the structural integrity of junctions with sidewalls and sumps.

service-water system (SWS). The total area required for the proposed two power-generating units, four CWS cooling towers, and associated structures for the CWS would be approximately 100 ac (Duke 2013c). Figure 3-2 is a rendering of how the proposed Units 1 and 2 and CWS cooling towers would appear on the site.

Figure 3-2. Artist Rendering of Proposed Units 1 and 2 Superimposed on the Lee Nuclear Station Site (Duke 2012g)

3.2 Proposed Plant Structures

This section describes each of the major plant structures: the reactor power system, structures that would have a significant interface with the environment during operation, and the balance of plant structures. All of these structures are relevant in the Chapter 4 discussion of the impacts of building proposed Units 1 and 2. Only the structures that interface with the environment are relevant to the operational impacts discussed in Chapter 5.

3.2.1 Reactor Power-Conversion System

Duke has proposed building and operating two Westinghouse AP1000 nuclear power reactors at the Lee Nuclear Station site. On January 27, 2006, the NRC issued the final design certification rule for the AP1000 in the *Federal Register* (71 FR 4464) based on Revision 15 of the AP1000 Design Control Document (DCD). Westinghouse requested to amend the AP1000 DCD with Revision 19 (Westinghouse 2011). Based on a review of Revision 19, NRC issued the AP1000 design certification amendment final rule in the *Federal Register* on December 30, 2011 (76 FR 82079). DCD amendment review documents are available at http://www.nrc.gov/reactors/new-reactors/design-cert/amended-ap1000.html. Each applicant or licensee intending to construct and operate a plant based on the AP1000 design may do so by referencing its design certification rule, as set forth in Appendix D to Title 10 of the *Code of Federal Regulations* (CFR) Part 52. The reactor design referenced in Duke's application is Revision 19 of the certified design (Westinghouse 2011). Figure 3-3 is an illustration of the reactor power-conversion system. Each AP1000 reactor is connected to two steam generators, which transfer heat from the reactor core, converting feed water to steam that drives the turbines that turn the generator, thereby creating electricity. Steam that has passed through the turbines is condensed back to water that is heated and pumped back to the steam generators, repeating the cycle. The AP1000 design has a thermal power rating of 3400 MW(t), with a design gross electrical output of approximately 1200 MW(e). The expected net electrical output for each unit would be 1117 MW(e) (Duke 2009c).

3.2.2 Structures with a Major Environmental Interface

The review team divided plant structures into two primary groups: (1) those that interface with the environment and (2) those that are internal to the reactor and associated facilities but without direct interaction with the environment. Examples of interfaces with the environment are withdrawal of water from the environment at the intake structures, release of water to the environment at the discharge structure, and release of excess heat to the atmosphere. The structures or locations with environmental interfaces are considered in the review team's assessment of the environmental impacts of facility construction and preconstruction in Chapter 4 and of facility operation in Chapter 5. The power-production processes that would occur within the plant itself and that do not affect the environment are not relevant to a National Environmental Policy Act of 1969, as amended (NEPA) review and are not discussed further in this EIS. However, such internal processes are considered by the NRC staff in the Westinghouse AP1000 DCD and in NRC safety reviews of the Lee Nuclear Station Units 1 and 2 combined construction permit and operating license (COL) application. This section (3.2.2) describes the structures with significant plant-environment interfaces. The remaining structures are discussed in Section 3.2.3, inasmuch as they may be relevant in the review team's consideration of impacts discussed in Chapter 4 of this EIS.

Figure 3-4 illustrates the Lee Nuclear Station site layout with a grid overlay to reference the locations of various plant structures and activity areas as they are described in the following sections. Structures for the proposed Units 1 and 2 are located primarily in grid reference area C2.

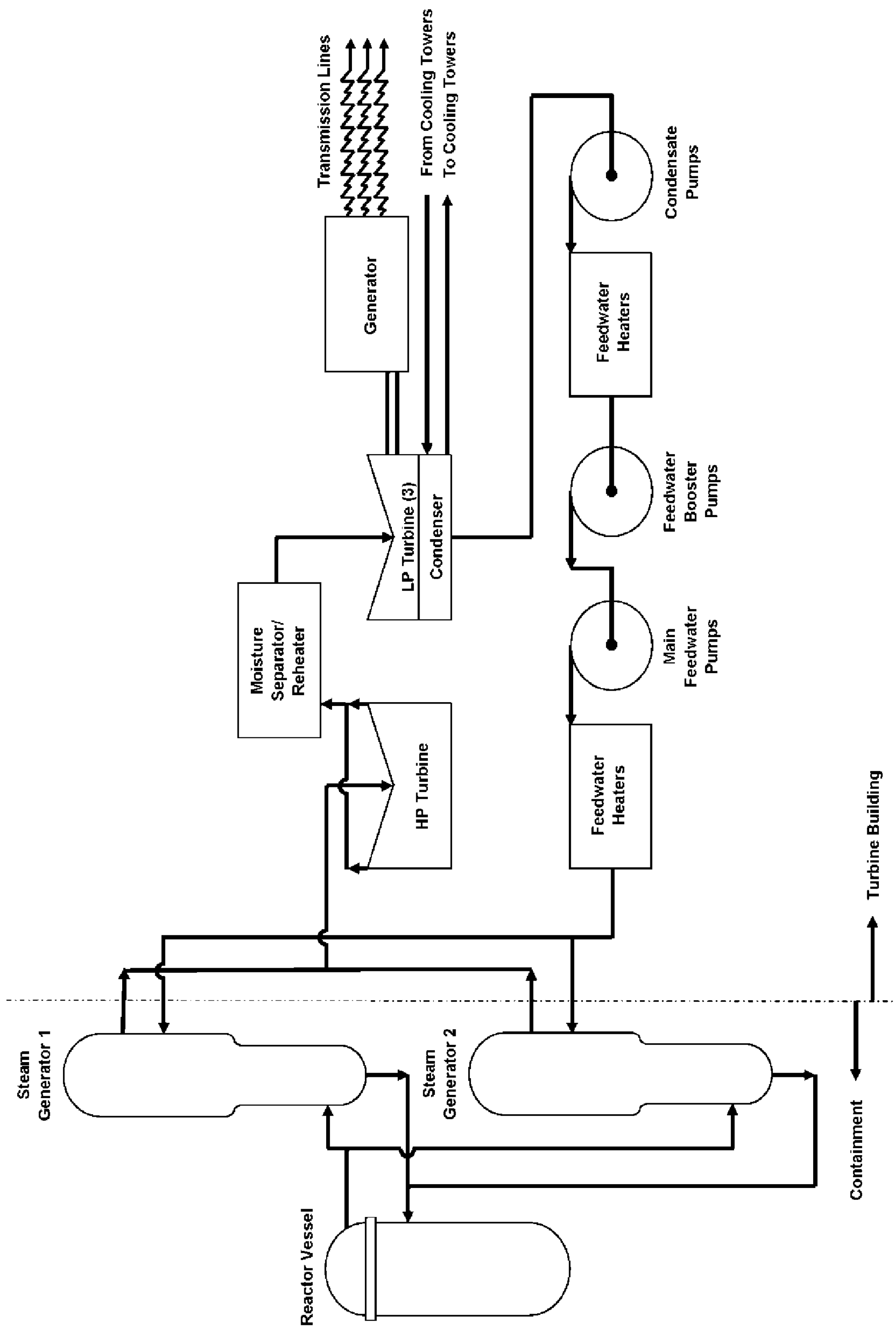

Figure 3-3. AP1000 Power-Conversion Diagram (Duke 2009c)

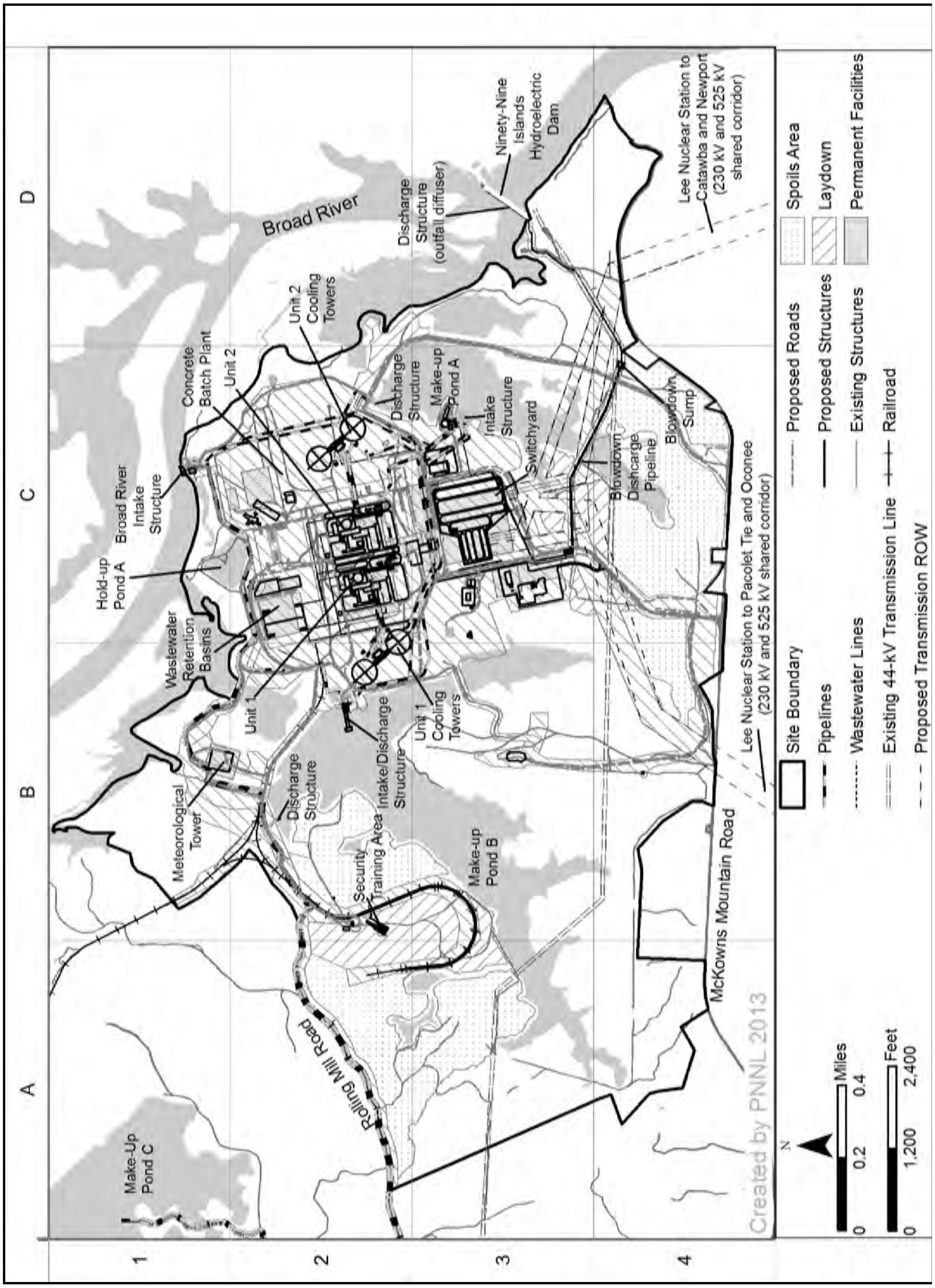

Figure 3-4. Lee Nuclear Station Site Layout Showing Major Structure and Activity Areas for Proposed Units 1 and 2

3.2.2.1 Landscape and Stormwater Drainage

Landscaping and the stormwater-drainage system affect both the recharge to the subsurface and the rate and location at which precipitation drains into adjacent creeks and streams. Impervious areas eliminate recharge to aquifers beneath the site. Pervious areas managed to reduce runoff and kept free of vegetation would experience considerably higher recharge rates than adjacent areas with vegetation. The stormwater management system, including site grading, drainage ditches, swales, retention ponds, and Make-Up Ponds A and B, has safety and environmental functions, keeping locally intense precipitation from flooding safety-related structures and preventing runoff from adversely affecting the environment.

The proposed site would be graded so that stormwater is diverted from Units 1 and 2 to Make-Up Pond A, Make-Up Pond B, or the Broad River (Duke 2009c, 2013a).

3.2.2.2 Cooling System

The cooling system represents the largest interface between the plant and the environment. Makeup water from the Broad River would be provided to the plant via Make-Up Pond A. During periods of low flow when withdrawals from the Broad River are limited, makeup water would be provided from Make-Up Ponds B and C to Make-Up Pond A (Duke 2010f). A portion of the makeup water would be returned to the environment via a discharge structure, also in the Broad River on the upstream side of Ninety-Nine Islands Dam (Figure 3-4). The remaining portion of the water would be released to the atmosphere via evaporative cooling through mechanical draft cooling towers. These components represent interfaces between the plant and the environment. This section describes the components of the proposed cooling system based on the information provided by Duke in its ER, in its supplemental ER regarding Make-Up Pond C (Duke 2009b, c), FSAR (Duke 2013a), and in other supplemental documentation (Duke2010c, f, k-m, 2011e-f, h, 2012e, g-i, 2013c).

Make-Up Ponds A, B, and C

The cooling system for the proposed Units 1 and 2 includes three constructed impoundments: Make-Up Pond A and Make-Up Pond B, which presently exist on the Lee Nuclear Station site, and Make-Up Pond C, which would be built on the London Creek watershed to the northwest of the Lee Nuclear Station site (Figure 3-1). Duke's initial COL application for Units 1 and 2 relied on the existing Make-Up Ponds A and B and the Broad River to supply cooling water; a supplemental water source was not proposed (Duke 2007b). However, low flows in the Broad River during the summer and fall of 2007 resulted in an increased awareness that a severe long-term drought could affect the reliability of baseload generation at the Lee Nuclear Station site, and Duke determined that it was prudent to propose auxiliary water storage for periods of prolonged drought. In addition, the South Carolina Department of Natural Resources expressed concerns that water supply was insufficient to ensure future uninterrupted operation of Lee

Nuclear Station when Broad River water availability was limited by minimum flow requirements (SCDNR 2008b). Therefore, Duke proposed Make-Up Pond C in its 2009 supplement to the ER (Duke 2009b).

Key characteristics of each impoundment are provided in Table 3-1. Duke's estimates of average daily evaporation rates by month are provided in Table 3-2 (Duke 2011e). Evaporation in each pond is a function of surface area, which varies with pond elevation. For example, during June if Make-Up Pond C was at full pool elevation with a surface area of 618 ac, Duke estimated that evaporation would result in a loss of 8.34 ac-ft/d or 4.21 cfs (Table 3-2).

Table 3-1. Elevation, Area, Depth, and Storage Volume of Make-Up Ponds A, B, and C

Impoundment	Normal (full pool) Elevation (ft MSL)	Surface Area at Normal Elevation (ac)	Maximum Depth (ft)	Total Storage Volume (ac-ft)	Maximum Drawdown (ft)	Usable Storage Volume (ac-ft)
Make-Up Pond A	547[a]	62[a]	57[a]	1425[a]	29[a]	1200[b]
Make-Up Pond B	570[a]	152[c]	59[a]	3994[c]	30[c]	3156[c]
Proposed Make-Up Pond C	650[c]	618[c]	116[c]	22,023[c]	45[c]	17,493[c,d]

(a) Source: Duke 2009c
(b) Source: Duke 2013a
(c) Source: Duke 2009b.
(d) Duke estimated that 12,374 ac-ft would be needed to sustain plant operation during an extended drought; the remaining "usable storage" volume would stay in Make-Up Pond C to provide a zone of aquatic refuge (Duke 2011h).

Table 3-2. Duke Estimates of Daily Average Evaporation Rates

Month	Daily Evaporation Rate (ft/d)[a]	Daily Evaporation Rate for Make-Up Ponds (cfs)[a]		
		Make-Up Pond A	Make-Up Pond B	Make-Up Pond C
January	0.00351	0.11	0.27	1.09
February	0.00512	0.16	0.39	1.59
March	0.00777	0.24	0.60	2.42
April	0.01081	0.34	0.83	3.37
May	0.01217	0.38	0.93	3.79
June	0.01350	0.42	1.03	4.21
July	0.01361	0.43	1.04	4.24
August	0.01245	0.39	0.95	3.88
September	0.00965	0.30	0.74	3.01
October	0.00708	0.22	0.54	2.21
November	0.00478	0.15	0.37	1.49
December	0.00337	0.11	0.26	1.05

Source: Duke 2011e
(a) Daily evaporation rate incorporating pan evaporation values for Clemson, South Carolina, during period July 1948 through 2010 (Duke 2011e).

Make-Up Pond A

Make-Up Pond A, located southeast of proposed Units 1 and 2, is an arm of Ninety-Nine Islands Reservoir impounded by an earthen dam built in the late 1970s (Duke 2009c). Make-Up Pond A serves as the source of water for the plant CWS and treatment system for other plant uses. Water from the Broad River would be delivered to Make-Up Pond A through a discharge structure in the northwest corner of the pond (Figure 3-4, grid reference C2). During periods of low flow in the Broad River, Make-Up Pond A would receive water from Make-Up Pond B through the same discharge structure.

Make-Up Pond B

The primary function of Make-Up Pond B would be to maintain normal water levels in Make-Up Pond A when withdrawals from the Broad River are reduced or terminated due to low flow (Duke 2010f). Make-Up Pond B, located west of proposed Units 1 and 2, receives water from McKowns Creek and surface runoff. This natural recharge from McKowns Creek and surface runoff can be supplemented by pumping from Make-Up Pond A during normal operations, and pumping from Make-Up Pond C when withdrawal from the Broad River is restricted due to low flow. If needed, and if flow in the Broad River is sufficient, Make-Up Pond B also can be filled by pumping directly from the Broad River intake. Water transfers between makeup ponds during plant operation are described in Section 3.4.2.1. Water sent to Make-Up Pond B from the Broad River or from Make-Up Pond C enters the pond through a discharge structure in the northwest corner of the pond (Figure 3-4; water from Make-Up Pond A would enter Make-Up Pond B through a pipe in the Make-Up Pond B intake structure (Figure 3-4, grid reference B2).

Make-Up Pond C

Make-Up Pond C would be created by damming the London Creek drainage upstream of the confluence of Little London Creek, located northwest of proposed Units 1 and 2. The inundated area, impounding structures, intake/discharge structure, pipeline, and other features associated with Make-Up Pond C are shown in Figure 3-5. Duke considered three water-storage components when sizing Make-Up Pond C (Duke 2010l). The primary component was the volume required to support station operations through a drought period, which was based on the number of days of drought on record, the maximum consumptive use rate of 63 cfs, and a 25 percent margin of safety. Duke estimated this volume to be 11,743 ac-ft. The other two components were specific to the topography of the inundated area: (1) the volume needed to avoid disruption of the thermal stratification (assumed to occur in the upper 20 ft of the reservoir, based on observed stratification depths in Make-Up Ponds A and B and Monticello Reservoir), and (2) the volume needed to keep the intakes clear of debris and sediment. Duke estimated these volumes to be 10,133 ac-ft and 147 ac-ft, respectively (Duke 2010l). In its CWA § 316(b) compliance demonstration prepared for the National Pollutant Discharge Elimination System (NPDES) permit application, Duke showed that, at the proposed Make-Up Pond C elevation of

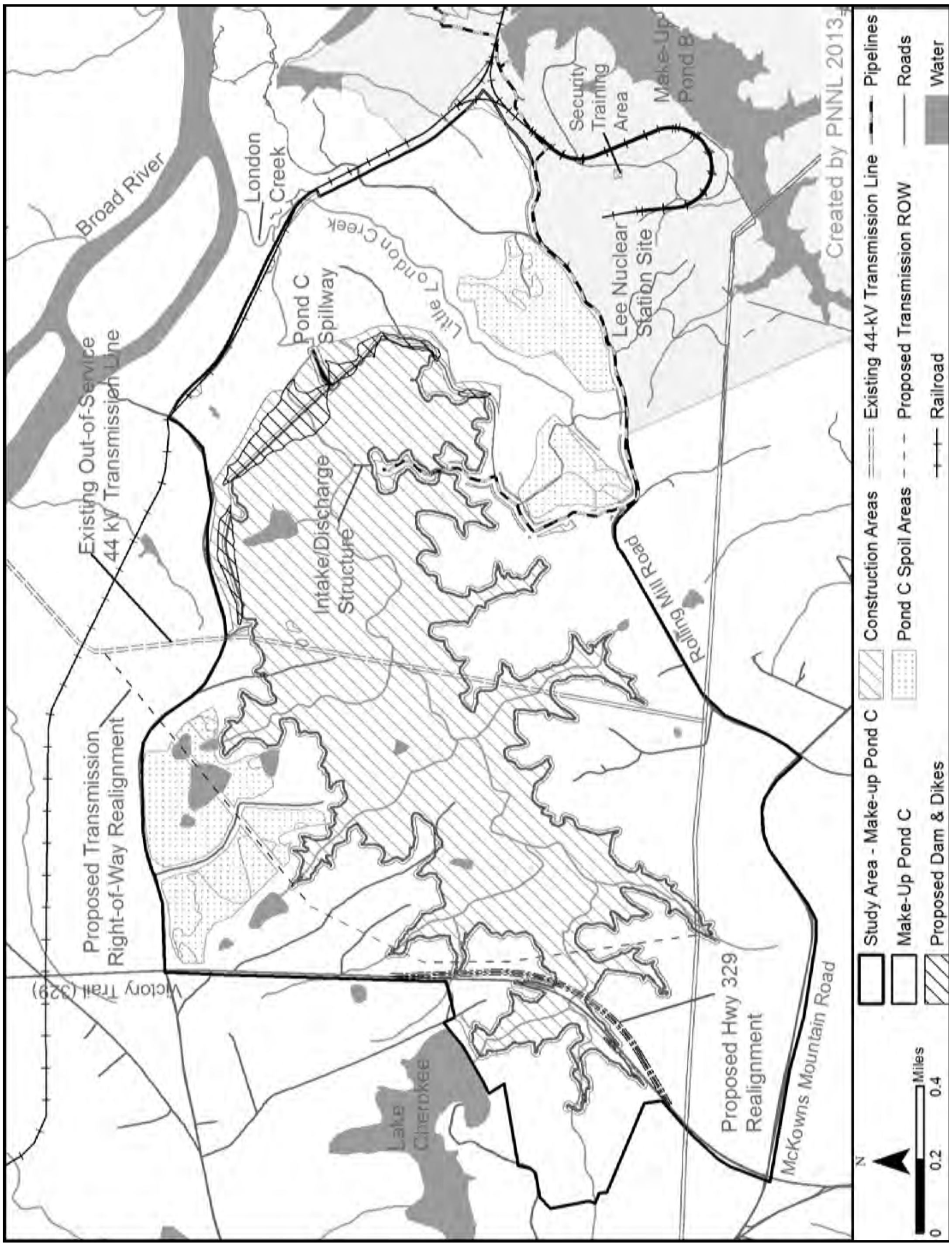

Figure 3-5. Study Area, Inundated Area, Structures, and Activity Areas Associated with Proposed Make-Up Pond C

650 ft above MSL, the proposed new units could be operated 20 days longer than the longest recorded drought within the watershed and that disruption of thermal stratification in the proposed reservoir could be avoided (Duke 2011h, i).

Make-Up Pond C would have a surface area of approximately 620 ac and a maximum depth of 116 ft at its normal pool elevation of 650 ft above MSL (Table 3-1). During normal operations, the level of Make-Up Pond C would be maintained by pumping water from Make-Up Pond B through the combined intake/discharge structure in the southeast corner of Make-Up Pond C (Figure 3-5). Natural precipitation and runoff is expected to contribute an average of 236 gpm to Make-Up Pond C (Duke 2009b). During periods when withdrawal from the Broad River is restricted due to low flows, water can be pumped from Make-Up Pond C to Make-Up Pond B. Following periods when Make-Up Pond C has been drawn down to support plant operations, and flow in the Broad River is sufficient to allow it, Make-Up Pond C can be refilled by pumping water directly from the Broad River intake (Duke 2010f). Operational drawdowns and water transfers between Make-Up Ponds A, B, and C during low-flow conditions in the Broad River are discussed further in Section 3.4.2.1.

Cooling-Water Intake Structures

Broad River Intake Structure

The Broad River intake structure would house two subsystems. The river water (plant raw-water supply) subsystem would supply water to Make-Up Pond A for all plant cooling and non-cooling needs except for potable water. The refill subsystem also would supply water to refill Make-Up Ponds B and C during normal and high flows, if those ponds were drawn down during low flows. The Broad River intake structure would be located on the north side of the Lee Nuclear Station site where the riverbank slope is relatively steep (Figure 3-4, grid reference C1). The Broad River intake would be a concrete structure approximately 142 ft long and approximately 64 ft wide at its base, placed parallel to river flow and flush with the riverbank (Duke 2010f). The proposed design is for eight pumps, four for each subsystem. Four of the pumps (two operating and two on standby) would pump water to Make-Up Pond A for the plant raw-water supply. The other four pumps would be used to directly fill Make-Up Ponds B and C if needed and if permitted by Broad River flow conditions (Duke 2010f). Each pump would be located in a separate pump bay approximately 13 ft wide with a bar rack to trap large debris and a traveling screen system to keep fish and finer debris from entering the plant water system. The traveling screens would be a modified Ristroph design with 0.375-in. mesh and a design through-screen velocity of less than 0.5 fps (Duke 2012i). A system of Fletcher buckets on each screen basket and a low-pressure wash to separate fish from debris would move fish to a trough that would return them to the river downstream of the intake structure. A separate high-pressure wash system would wash debris to a separate trough (Duke 2008i, 2009b). The location of the Broad River intake structure on the riverbank is shown in Figure 3-6. A plan view of the Broad River intake structure is shown in Figure 3-7, and a cross-section view through a pump bay of the Broad River intake structure is shown in Figure 3-8.

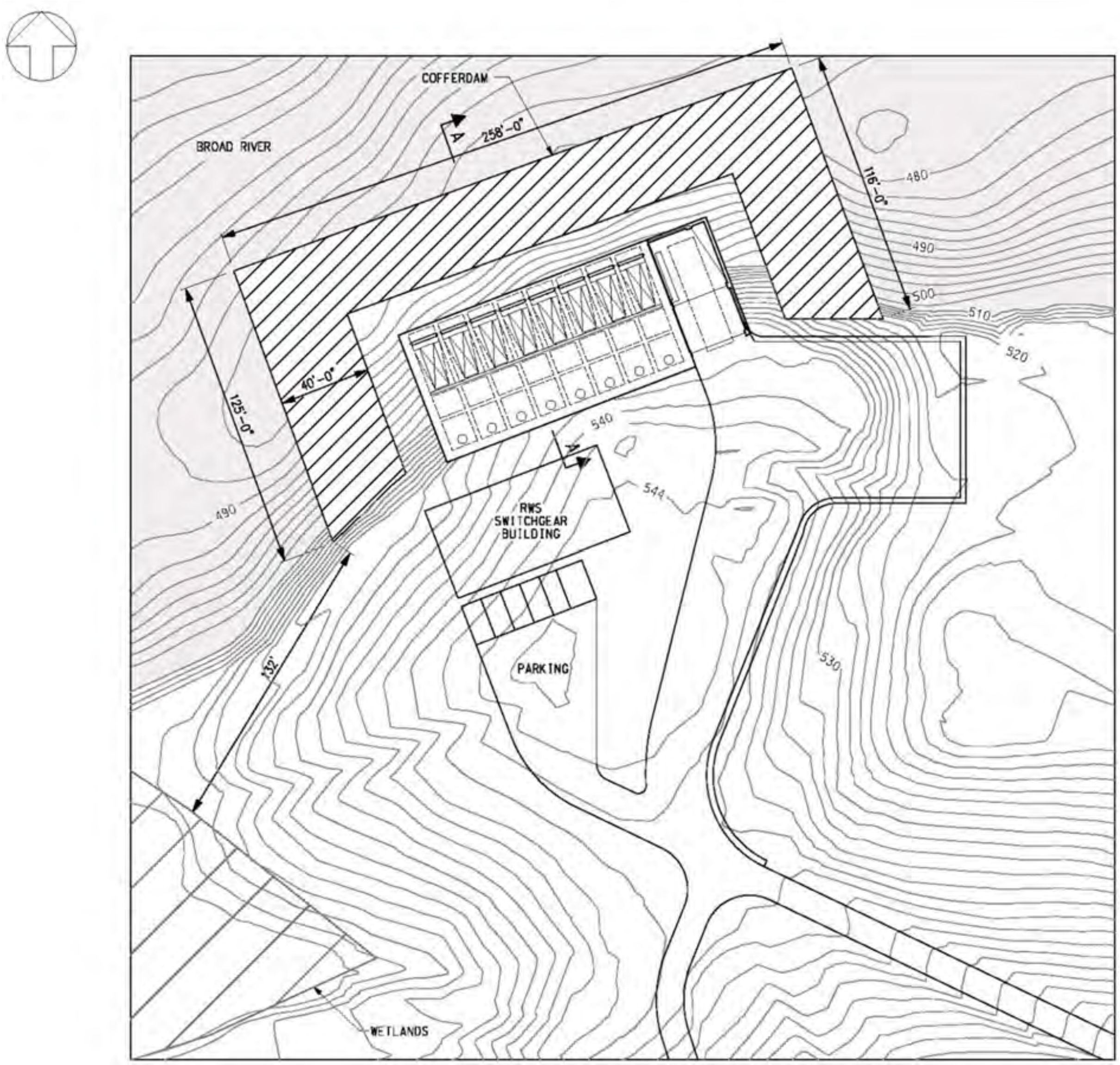

Figure 3-6. Planned Configuration of the Broad River Intake (Duke 2012h)

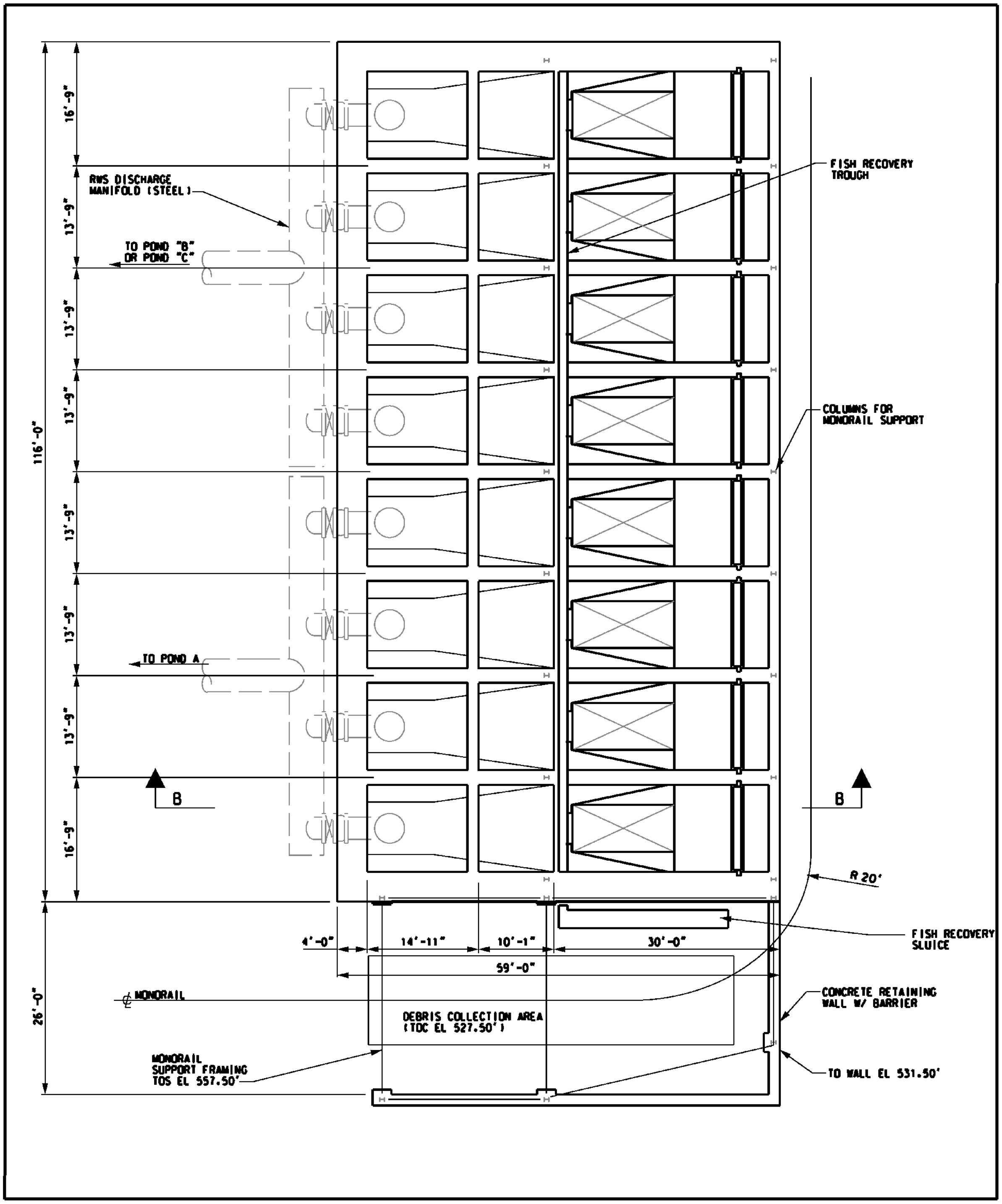

Figure 3-7. Plan View of the Broad River Intake Structure (Duke 2012h)

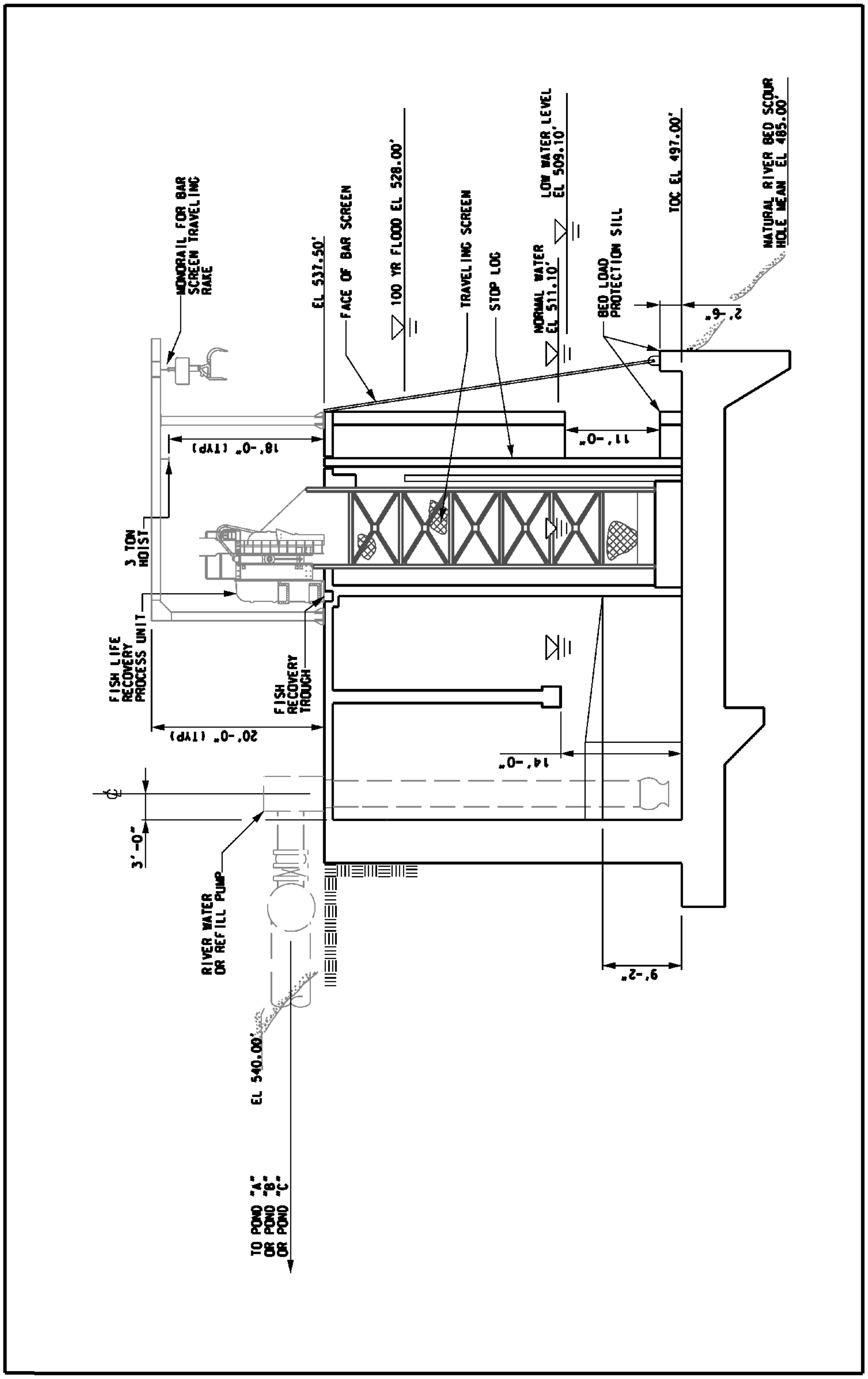

Figure 3-8. Cross-Sectional View of the Broad River Intake Structure (Duke 2012h)

Make-Up Pond A Intake Structure

The intake structure in Make-Up Pond A would pump water to the CWS and the water-treatment system that feeds the SWS and demineralized-water system. The Make-Up Pond A intake structure would be located on the west bank of Make-Up Pond A, approximately 2000 ft southeast of proposed Unit 2 (Figure 3-4, grid reference C3). The intake would be constructed of concrete; would be approximately 70 ft long and 61 ft wide at its base, and would house four raw-water pumps (two pumps per AP1000 unit), each in an individual pump bay (Duke 2012h). The planned layout of the intake structure on the shoreline of Make-Up Pond A is shown in Figure 3-9. Three pumps would operate full time to maintain the supply to the cooling towers; the fourth pump would be on standby (Duke 2012g). Each pump bay would have bar racks to exclude large debris and dual-flow traveling screens to exclude fish and smaller debris (Duke 2010l, m; Duke 2012g). The design through-screen velocity would be less than 0.5 fps. A plan view of the Make-Up Pond A intake system's four pump bays is shown in Figure 3-10, and a cross-sectional view of one pump bay is shown in Figure 3-11.

Make-Up Pond B Intake Structure

The Make-Up Pond B intake structure would be located on the northeast shore of the pond, about 2000 ft west of the proposed Unit 1 (Figure 3-4, grid reference B2). The intake structure would be located at the end of a 40-ft-wide causeway that would extend approximately 375 ft from the existing shoreline to a point where the pond is approximately 50 ft deep at normal pool elevation. The structure itself would be a concrete wet well approximately 44 ft by 88 ft, and 60 ft in height from its base at about 520 ft above MSL to the pump station platform at an elevation of about 580 ft above MSL (Duke 2010m). A pump station platform at the end of the causeway would house five pumps: two pumps per unit to transfer water to Make-Up Pond A and one pump to transfer water to Make-Up Pond C (Duke 2009c, 2010f). Water would enter the intake structure through inlet pipes at the bottom of the structure. Each inlet would be fitted with a passive wedge wire cylindrical drum screen that can be raised to the surface for cleaning (Duke 2010l, m). The Make-Up Pond B intake structure would also house a pipe to refill Make-Up Pond B with water pumped from Make-Up Pond A.

The causeway would consist of crushed stone fill for approximately 200 ft from the existing shoreline, and then would extend over the water on concrete piers to the intake structure and pumphouse. It would be designed to support a 20-ft-wide roadway and 54-in.-diameter water pipe (Duke 2010m). A plan view of the Make-Up Pond B intake structure is shown in Figure 3-12 and a side-profile view of the causeway, piers, and intake structure is shown in Figure 3-13. A cross-sectional view through the concrete wet well of the Make-Up Pond B intake structure is shown in Figure 3-14.

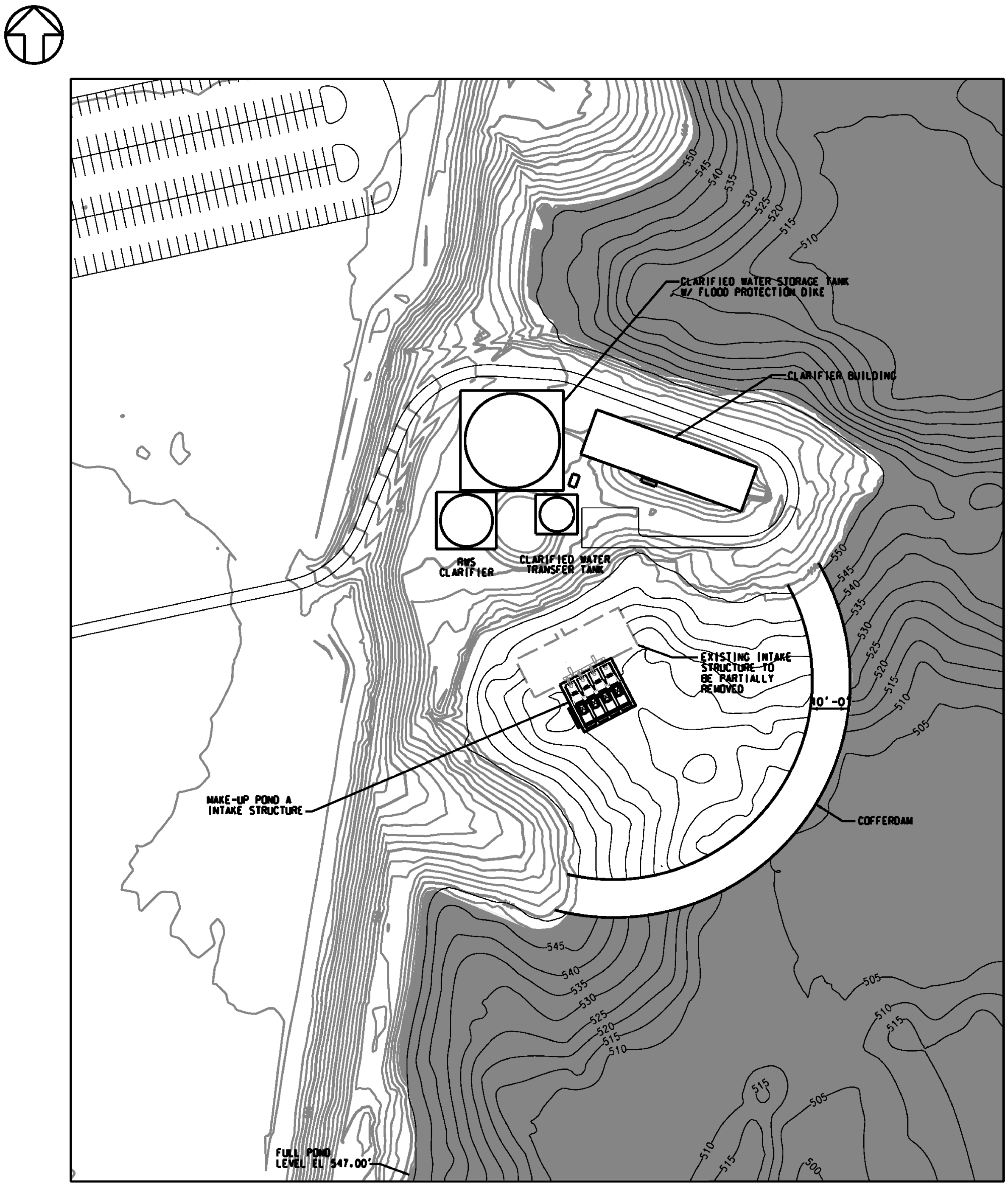

Figure 3-9. Planned Configuration of the Make-Up Pond A Intake Structure (Duke 2012h)

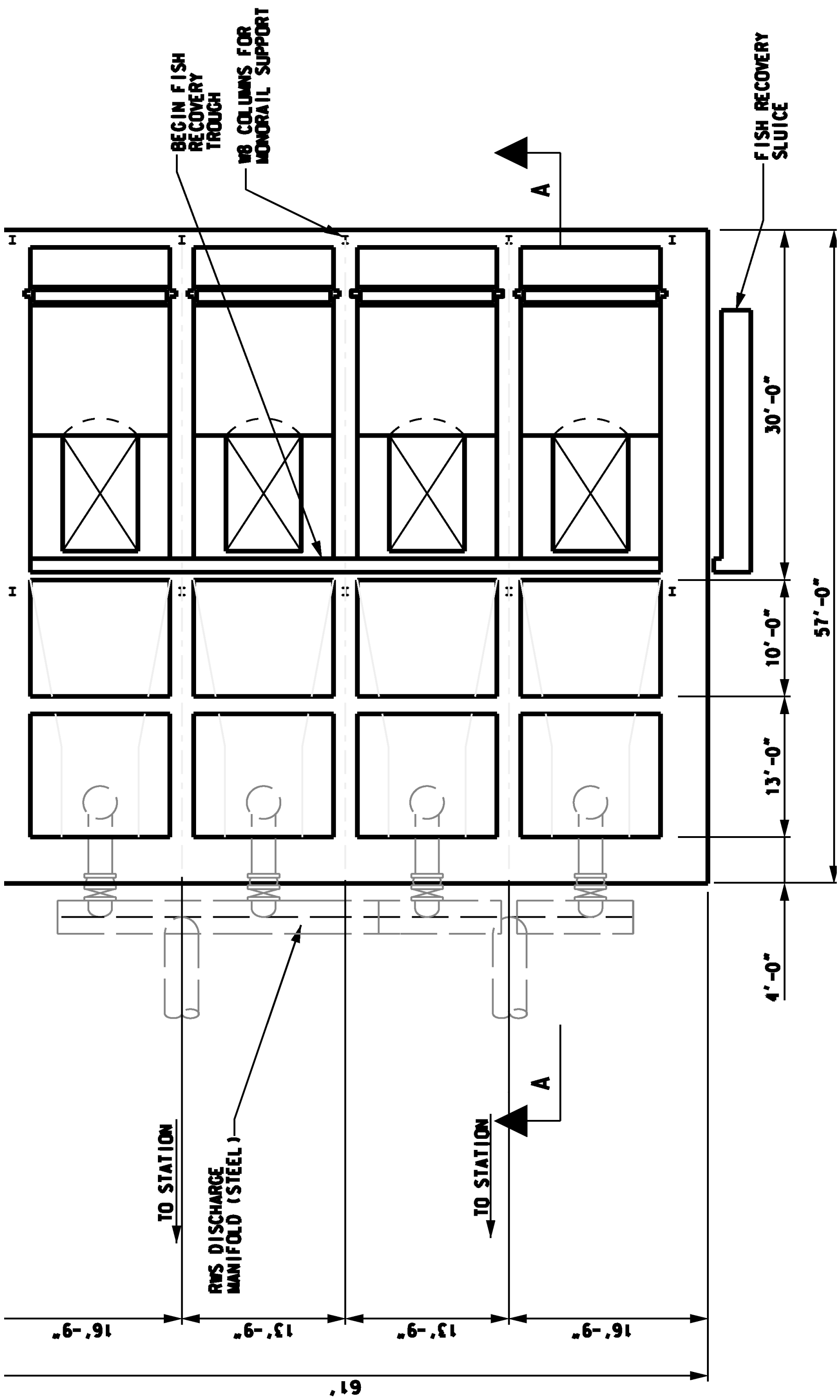

Figure 3-10. Plan View of the Make-Up Pond A Intake Structure (Duke 2012h)

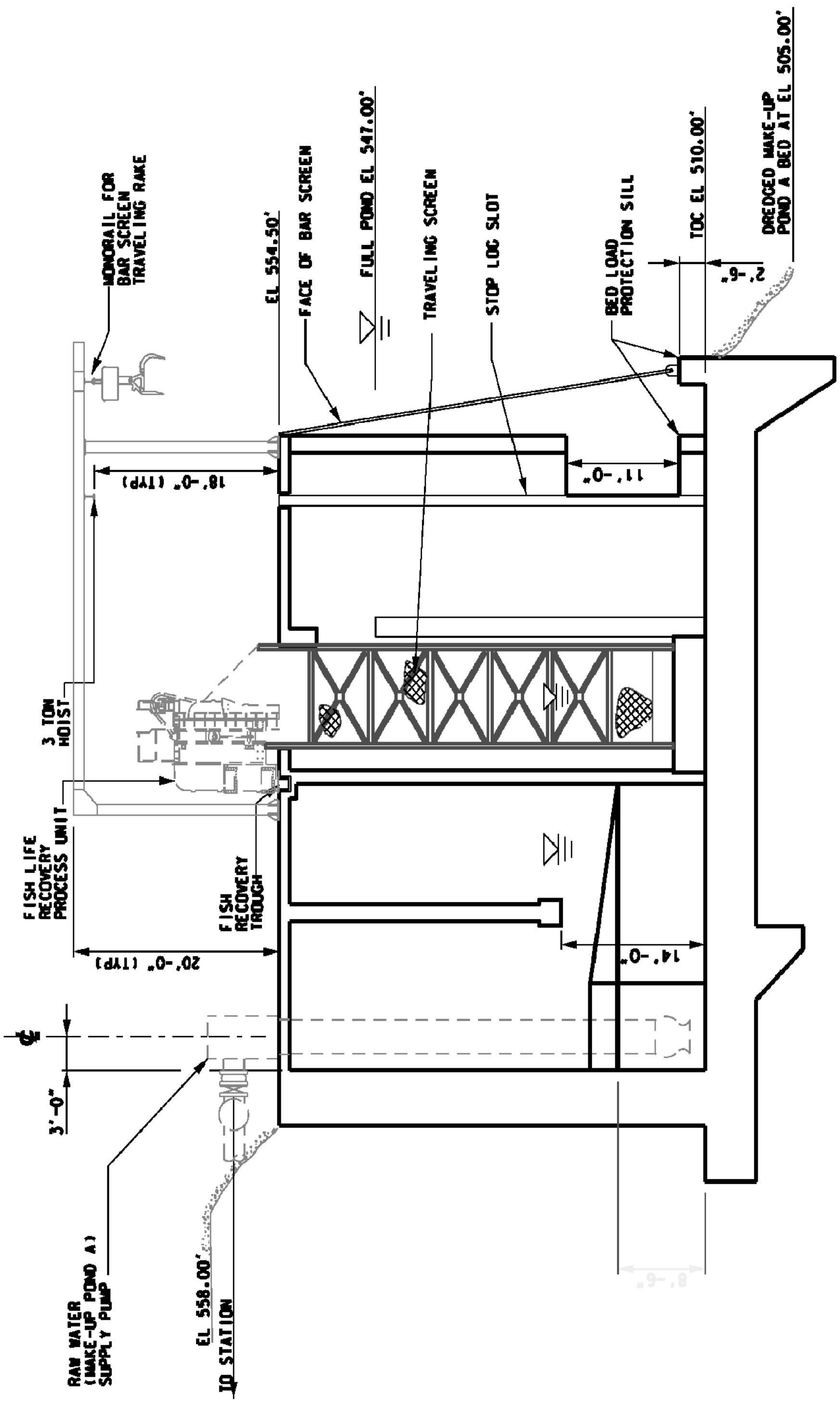

Figure 3-11. Cross-Section View of the Make-Up Pond A Intake Structure (Duke 2012h)

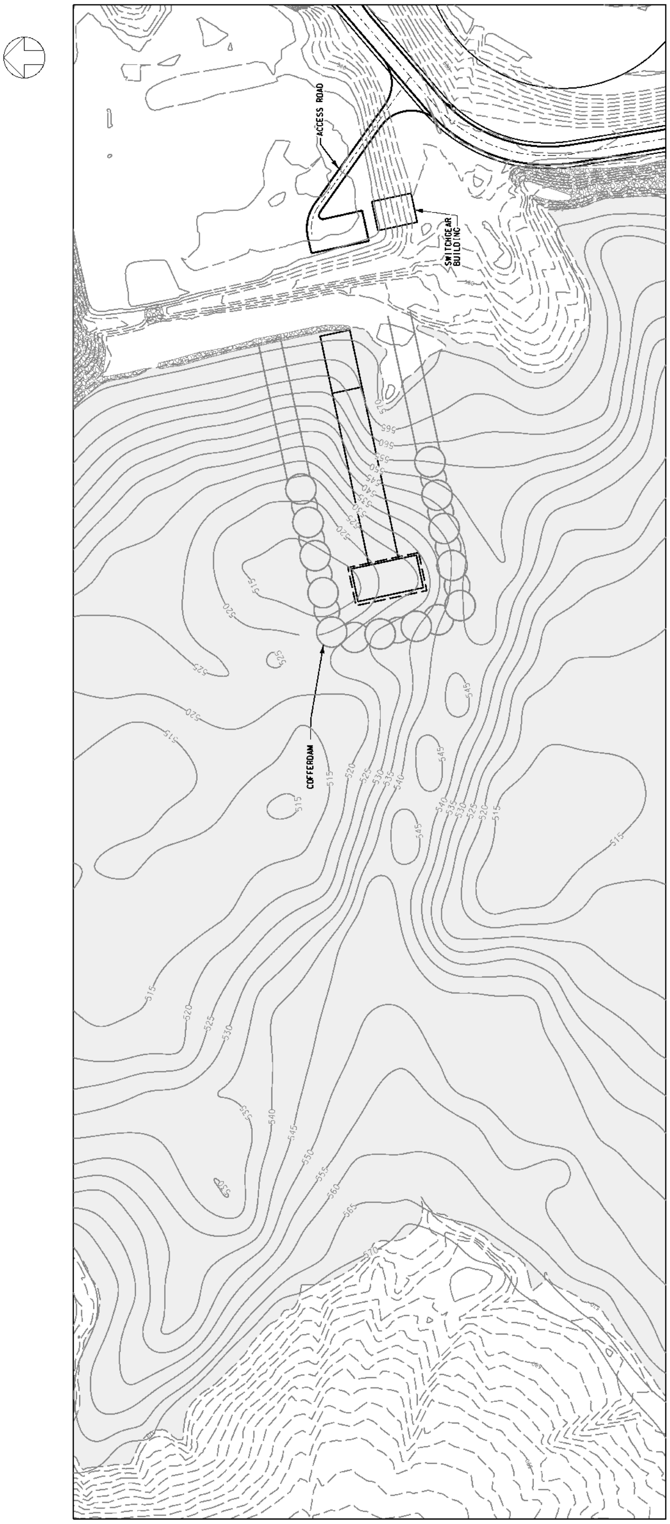

Figure 3-12. Planned Configuration of the Make-Up Pond B Intake Structure and Access Pier (Duke 2012h)

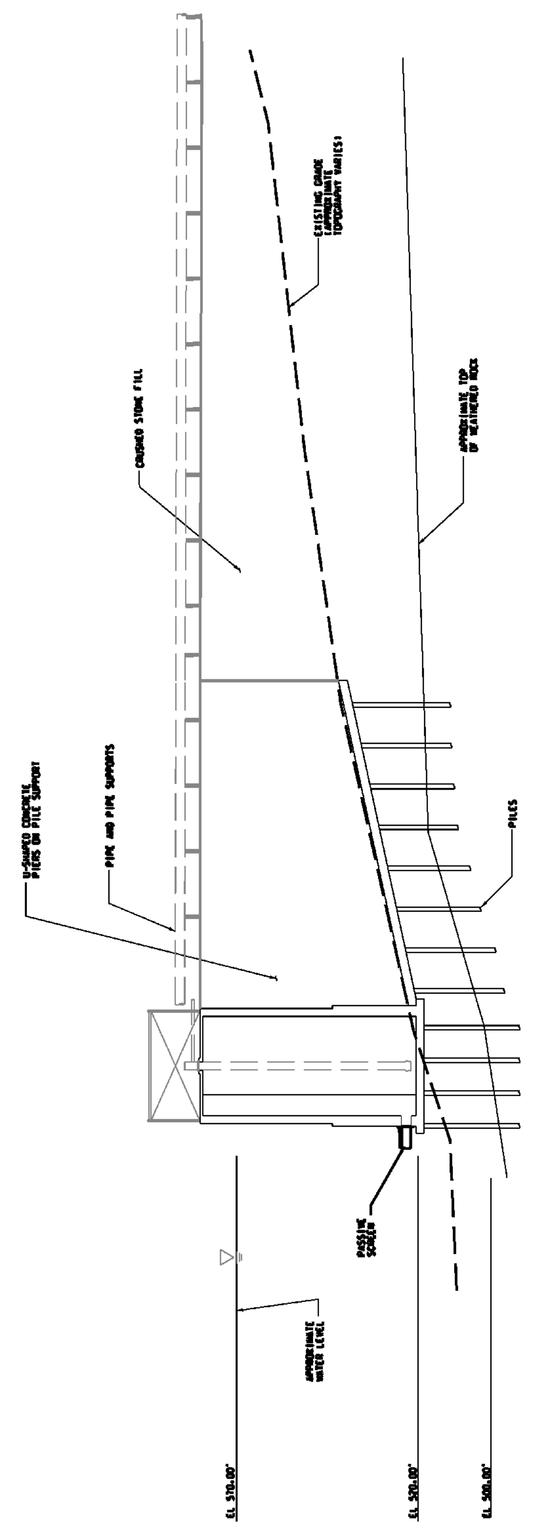

Figure 3-13. Side-Profile View of the Make-Up Pond B Intake Structure and Access Pier (Duke 2012h)

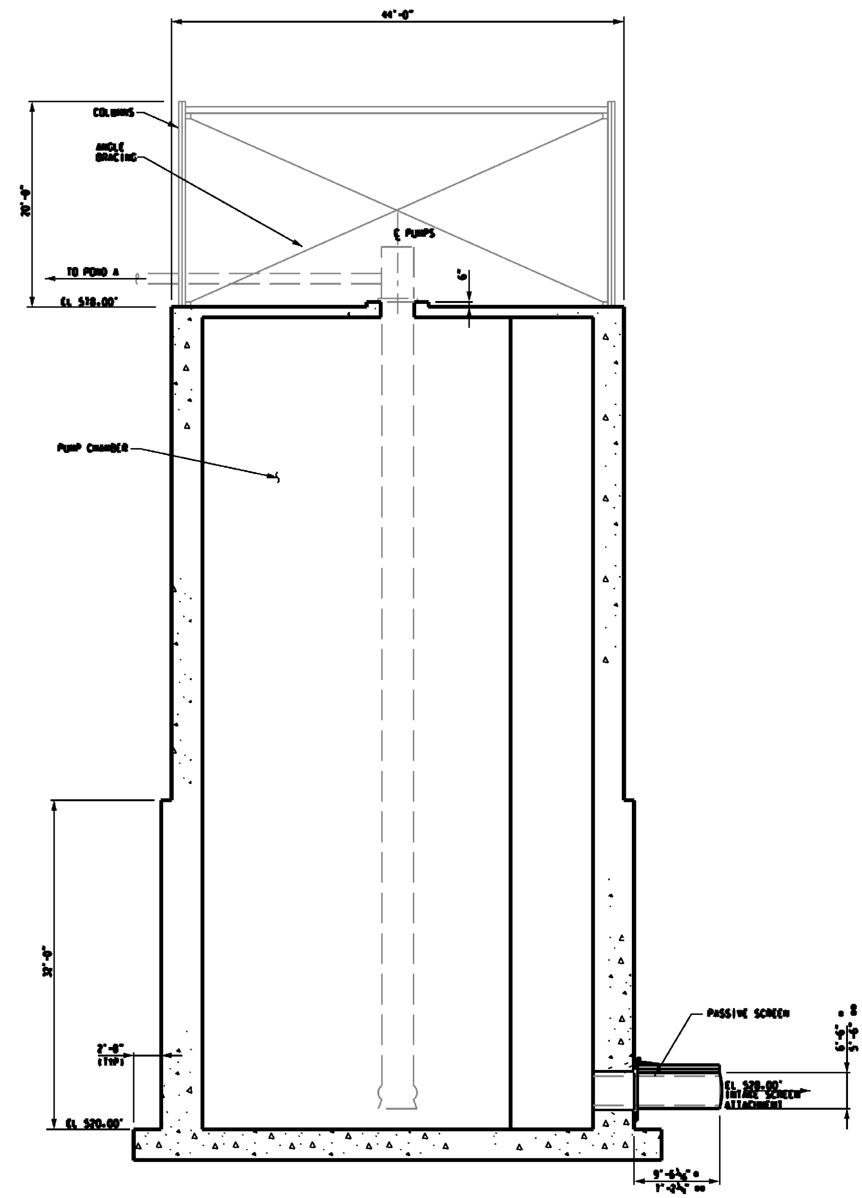

Figure 3-14. Cross-Section View of the Make-up Pond B Intake Structure (Duke 2012h)

Make-Up Pond C Intake/Discharge Structure

A combined intake and discharge structure is proposed for Make-Up Pond C. It would be located approximately 225 ft off the southeast shore in the deeper part of the pond (Figure 3-1, Figure 3-5). The structure would be a concrete wet well approximately 36 ft long, 42 ft wide, and 115 ft in height from its base at about 545 ft above MSL to the pump station platform at about 660 ft above MSL. Water would enter the intake structure through inlet pipes at the bottom of the structure. Each inlet would be fitted with a passive wedge wire cylindrical drum screen that could be raised to the surface for cleaning. The pump station would house three pumps that would only be used to transfer water to Make-Up Pond B if its storage capacity was depleted during very low-flow conditions (Duke 2009b, 2010f, m).

Access to the Make-Up Pond C intake/discharge structure would be provided by a bridge to the shore. The 225-ft-long, 32-ft-wide bridge deck would be supported by concrete piles and would be about 10 ft above the water surface at normal pool elevation (Duke 2010m). The bridge would support a 12-ft-wide access road and two 54-in.-diameter pipelines to carry water to and from the intake/discharge. A plan view of the Make-Up Pond C access bridge and intake structure is shown in Figure 3-15 and a side-profile view of the bridge and intake structure is shown in Figure 3-16. A cross-section view through the concrete wet well of the Make-Up Pond C intake structure is shown in Figure 3-17.

Discharge Structures

Blowdown and Wastewater Discharge Structure

Proposed Units 1 and 2 blowdown and wastewater discharges would flow through a 36-in.-inside-diameter high-density polyethylene (HDPE) pipeline to a discharge structure (outfall diffuser) on the upstream side of Ninety-Nine Islands Dam (Figure 3-4, grid reference D3). Between the blowdown sump and Ninety-Nine Islands Dam, the pipeline would be buried in a trench. Once the pipeline reaches the dam, the pipe would be fastened to the dam using steel braces. The pipe would extend approximately 925 ft along the upstream face of the dam and would end just before the intake structure for Ninety-Nine Islands Hydroelectric Station. The centerline of the pipe would be at an elevation of about 500 ft above MSL, so that the top of the pipe would be 10 ft below the water surface at normal full pond elevation. The section of the pipe closest to the hydroelectric station intakes would be perforated with holes so that the discharge would be diffused into the forebay of the dam. The diffuser configuration was designed to achieve an exit velocity of approximately 3.2 ft/s at an 18 cfs discharge rate (Duke 2012e). The water at the diffuser is approximately 12 to 15 ft deep, but Duke proposes to dredge the area to enhance mixing (DTA 2008a; Duke 2011f).

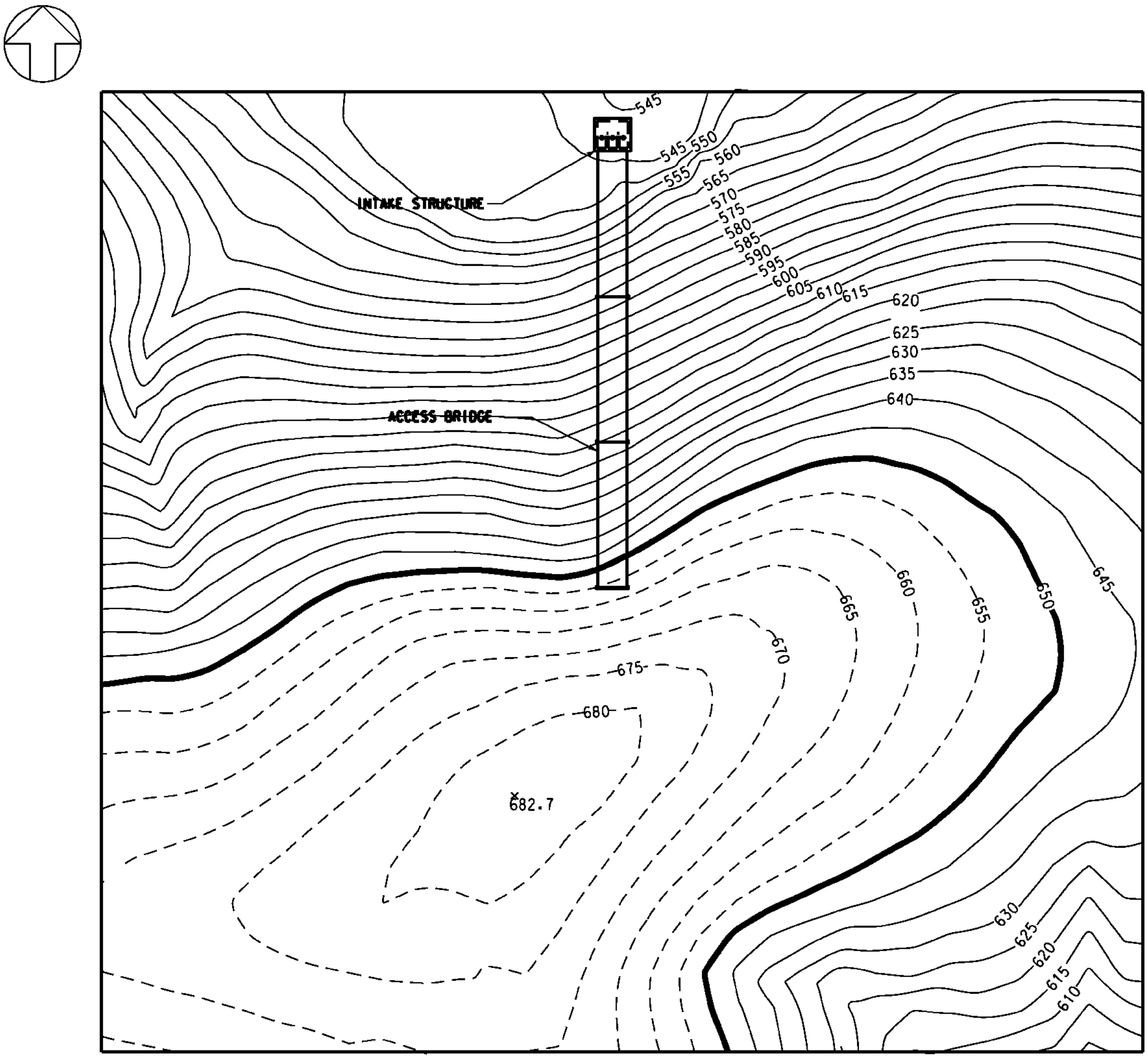

Figure 3-15. Planned Configuration of the Make-Up Pond C Intake Structure and Access Bridge (Duke 2012h)

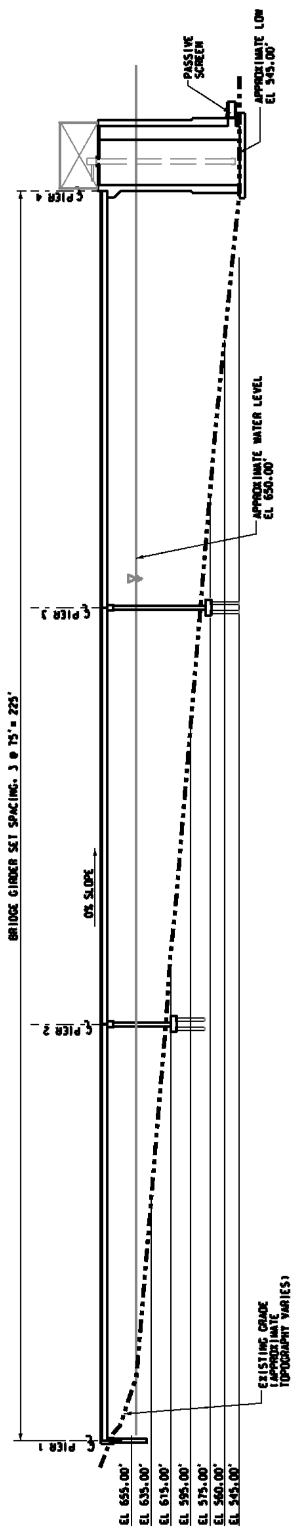

Figure 3-16. Side-Profile View of the Make-Up Pond C Intake Structure and Access Bridge (Duke 2012h)

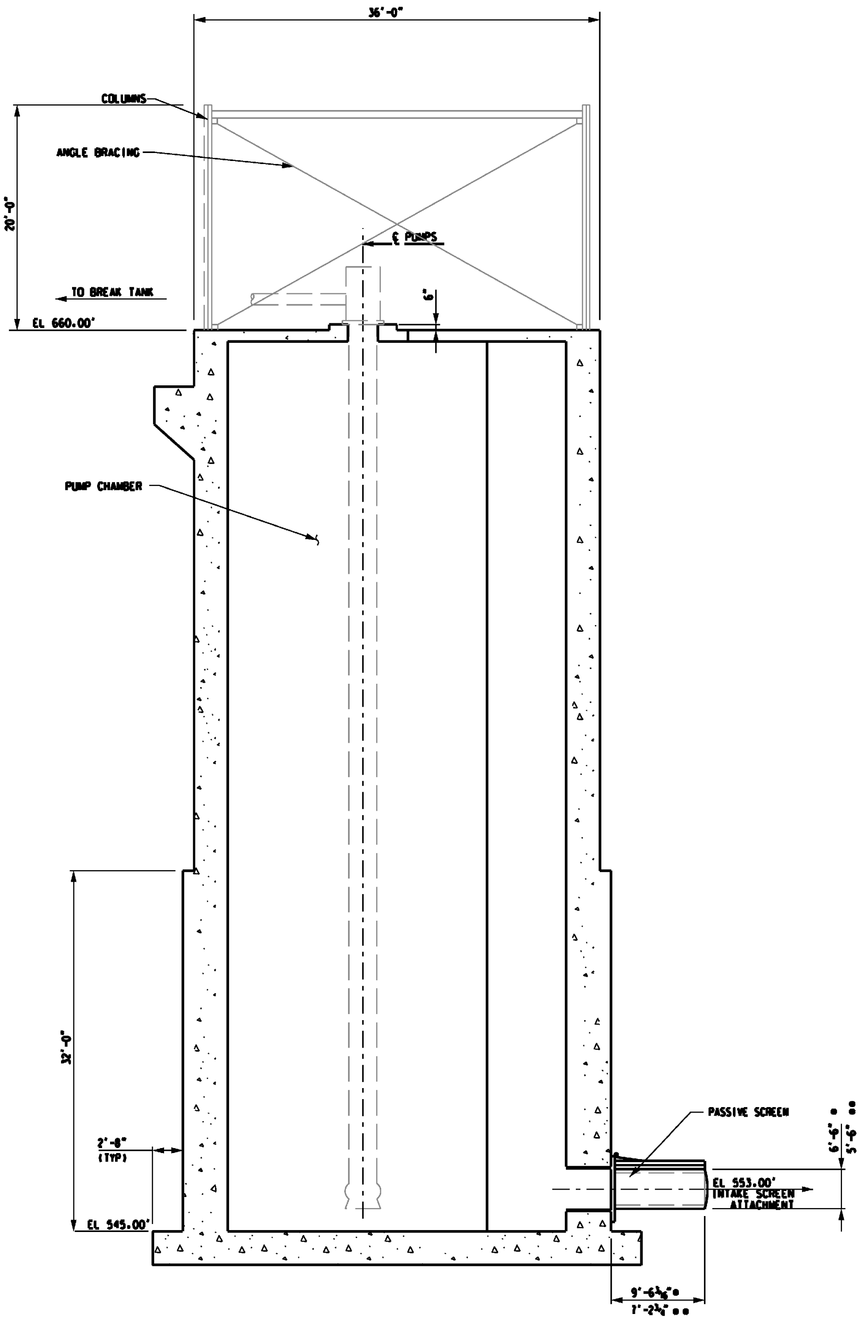

Figure 3-17. Cross-Section View of the Make-Up Pond C Intake Structure (Duke 2012h)

Make-Up Pond A Discharge Structure

Water from the Broad River (normal operations) or from Make-Up Pond B (low-flow operations) would enter Make-Up Pond A at a discharge structure located near the northwest corner of the pond (Figure 3-4, grid reference C2). HDPE piping would deliver water to a concrete retaining structure that is reinforced with riprap to protect its foundation and prevent scour (Duke 2010f).

Make-Up Pond B Discharge Structure

Water from the Broad River (during refill operations) or from Make-Up Pond C (low-flow operations) would enter Make-Up Pond B at a discharge structure located along the shoreline west of the Make-Up Pond B spillway (Figure 3-4, grid reference B2). A 54-in.-diameter pipe would deliver water to a 12 ft by 17 ft concrete box. Riprap would be placed adjacent to the discharge side of the concrete box to prevent scour and erosion (Duke 2009c).

Make-Up Pond C Discharge Structure

The Make-Up Pond C discharge structure is combined with the intake structure as described above (Figure 3-5). One of the 54-in.-diameter pipelines would carry water from the Broad River intake to the concrete wet well that is the combined Make-Up Pond C intake/discharge structure.

Cooling Towers

The proposed Units 1 and 2 would use closed-cycle cooling towers to dissipate heat from both the CWS and the SWS. As described in Section 3.1, each unit requires two cooling towers for the CWS; these are mechanical draft towers with circular concrete shells, approximately 360 ft in diameter at the base and 85 ft high. In each tower, fans blow air across water sprayed through fine nozzles to enhance evaporation, thereby removing heat. Two towers require approximately 10.6 ac (Figure 3-4, grid reference B2, C2). Each new unit also would have one cooling tower for the SWS located within the power block area, adjacent to the AP1000 turbine building. The SWS cooling towers are rectangular, two-cell mechanical draft cooling towers (Duke 2009c; Duke 2012g, 2013c).

3.2.2.3 Other Structures with a Permanent Environmental Interface

Roads, railroad lines, the power transmission system, and support buildings are additional structures with a permanent operational environmental interface that would be built on the proposed site.

Roads

The existing road network on the Lee Nuclear Station site would provide access to and between the proposed units and support facilities, although some of the existing roads would be improved to support construction equipment traffic, and some new roads are proposed (Figure 3-4). A heavy-haul road would be built between the east end of the railroad spur and the proposed Units 1 and 2 construction areas. Other roads between I-85 and the Lee Nuclear Station site would be improved to accommodate traffic during the construction period. Improvements would include widening and adding traffic signals and turn lanes at intersections, particularly those intersections providing site access along South Carolina Highway 329 (SC 329) and McKowns Mountain Road. Building Make-Up Pond C would involve realigning approximately 5000 ft of SC 329 to the east, adding a bridge over the area that would be inundated by Make-Up Pond C, and adding three culverts to facilitate drainage in the new alignment (Figure 3-5) (Duke 2009b,c; 2011h, 2012k).

Railroad Lines

Duke plans to re-establish a 6.8-mi-long railroad line connecting the Lee Nuclear Station site to the Norfolk Southern line in Gaffney, South Carolina (Figure 2-2). The railroad line would occupy the original cleared and graded right-of-way (ROW) except for approximately 1300 ft of track that would be routed to detour around the Reddy Ice Plant, which occupies part of the original ROW east of Gaffney (Duke 2009c). The proposed detour is shown in Figure 2-6. A larger 4-cell box culvert would be placed where the railroad line crosses London Creek below the proposed Make-Up Pond C impoundment and above its confluence with the Broad River (Figure 3-5). London Creek would typically flow through one of the culvert cells; the other culvert cells would carry water if the creek were more than 1 ft deep (about 36 cfs) or if high flow in the Broad River created backwater conditions (Duke 2009b, 2012j). On the Lee Nuclear Station site, a rail spur would continue east to the plant construction area, and another spur located north of Make-Up Pond B would provide a rail turnaround and railcar storage (Figure 3-4) (Duke 2013c).

Power Transmission System

In its COL application, Duke proposes to construct and operate two nuclear reactor units, with a total rated net electrical output capacity of 2234 MW(e), at the Lee Nuclear Station site. This section describes the transmission system needed to connect the proposed Units 1 and 2 to the existing power grid. Two new switchyards, a 230-kV switchyard connected by overhead lines to Unit 1 and a 525-kV switchyard connected by overhead lines to Unit 2, would be built adjacent to each other just south of the new units (Figure 3-4, grid reference area C3). The switchyards would be connected to each other through autotransformers, and would share support facilities.

Duke proposes to “fold in,” or incorporate by rerouting and connecting, the new switchyards to existing transmission lines that run east-west approximately 7 mi (the 230-kV Pacolet-Catawba line) and 14 mi (the 525-kV Oconee-Newport line) south of Lee Nuclear Station site. The new configuration will functionally reroute the existing lines to run through the Lee Nuclear Station switchyards (Figure 2-5). Physically, “folding-in” would break each existing line at two points several miles apart, turn the lines north from one break point and route them in a new ROW to the Lee Nuclear Station switchyards, and then would turn the lines back south from the switchyards in a separate new ROW to tie in at the other break point on the existing line. By using this approach, the section between the line breaks (tie-in locations) on each line would be de-energized, but not removed (Figure 2-5).

For grid stability reasons, two lines of the same voltage should be separated by at least 1 mi for the greatest possible distance, but a 230-kV line and a 525-kV line can run parallel to each other in a shared 325-ft-wide ROW (Duke 2009c). Therefore, the proposed fold-in configuration requires two new transmission-line ROWs between the Lee Nuclear Station and the break points on each line (Table 3-3, Figure 2-5). The proposed new ROWs, Routes K and O, were the result of a detailed transmission siting study in which more than 20 alternative routes were evaluated based on a range of land use and land cover, cultural and natural resource, water quality, property ownership and occupancy, and public and residential visibility factors (Duke 2007c). From the Lee Nuclear Station switchyards, one 230-kV line and one 525-kV line would run parallel to each other in a 325-ft-wide ROW along Route K to the tie-in point with the 230-kV line that continues west to Pacolet. From that point, the 525-kV line would run south in a 200-ft-wide ROW along Route K to the tie-in point with the 525-kV line that continues west to Oconee. The other new ROW, Route O, connects the switchyards to the existing lines to the east in a similar manner. One 230-kV line and one 525-kV line share a 325-ft-wide ROW to the tie-in point with the 230-kV line that continues east to Catawba Nuclear Station. From the 230-kV tie-in point, the 525-kV line runs south in a 200-ft-wide ROW along Route O to the tie-in point with the 525-kV line that continues east to Newport, South Carolina.

Structures associated with the transmission-line corridors are support towers and access roads. All tower structures would be designed so that span clearances would meet or exceed National Electrical Safety Code standards. The 525-kV lines would be supported on lattice steel towers 120 to 150 ft tall, with an average ruling span of 1300 ft. The 230-kV lines would be supported on double-circuit lattice steel towers ranging from 120 to 190 ft tall, with an average ruling span of 1000 ft. To meet standards for line sag and ground clearance, actual tower spacing depends on topography and land cover (Duke 2009c).

Table 3-3. Summary of New Transmission Lines for Proposed Lee Nuclear Station Units 1 and 2

Route	Size (kV)	Total Length (mi)	Length within Existing Corridor[(a)] (mi)	Existing Corridor Width (ft)	Length of New Corridor Needed[(b)] (mi)	New Corridor Segment (mi)	Segment Size (kV) and Corridor Width (ft)
Route O (Lee Nuclear Station to Catawba)	230 kV	32	25	150	14	7 mi (north)	230 kV and 525 kV share 325-ft corridor
Route O (Lee Nuclear Station to Newport)	525 kV	34	20	200		7 mi (south)	525 kV in 200-ft corridor
Route K (Lee Nuclear Station to Pacolet)	230 kV	25	17	150	17	8 mi (north)	230 kV and 525 kV share 325-ft corridor
Route K (Lee Nuclear Station to Oconee)	525 kV	103	86	200		9 mi (south)	525 kV in 200-ft corridor
Make-Up Pond C to Existing 44-kV Line	6.9 kV	3	0	NA[(c)]	3	NA	6.9 kV cable buried in access road and pipeline corridor

Sources: Duke 2007c, 2009b, k, 2010c, 2013d

(a) Length within existing corridor calculated as difference between total length and length of new corridor needed.

(b) Length of new corridor includes the 230-kV line for part of the distance (north segment only) and the 525-kV line for the full distance (north and south segments).

(c) NA = Not applicable.

In addition to the new 230-kV and 525-kV transmission lines needed to connect the proposed Lee Nuclear Station Units 1 and 2 to the existing grid, Duke proposes to install two new underground 6.9-kV, three-phase cables to provide power to the Make-Up Pond C intake/discharge facility. These cables would be approximately 3 mi long and would occupy the same corridor as the road and pipeline to the Make-Up Pond C intake structure (Figure 3-1, Figure 3-5) (Duke 2009b, 2010c, 2013d).

Finally, the proposed clearing and inundation of the London Creek drainage to form Make-Up Pond C would require removal of a portion of an existing 44-kV transmission line that once served residences in the Make-Up Pond C inundation area. The transmission-line corridor would be rerouted to skirt the west side of the pond, but no line would be installed as part of the project because no line is needed (Figure 3-1) (Duke 2011h).

3.2.2.4 Other Structures with a Temporary Environmental Interface

Some temporary (building-related) plant-environment interfacing structures would be removed before operation commences. These include a concrete batch plant and excavation dewatering systems. The impacts from the operation and installation of these structures are discussed in Chapter 4.

Concrete Batch Plant

A concrete batch plant would occupy approximately 3 ac located north of Make-Up Pond A (Figure 3-4, grid reference C2). This area would house the equipment and facilities needed for delivery, materials handling and storage, and preparation of concrete throughout the construction period for Units 1 and 2. Water for the concrete batch plant and other construction uses would be supplied by the Draytonville Water District (Duke 2009c, 2012b, e, g).

Dewatering Systems

Dewatering is expected to be a localized activity associated with deep excavation onsite, excavation for the proposed Make-Up Pond C dam footings, and work inside of cofferdams (Duke 2013a). An existing dewatering system in the excavation for the unfinished Cherokee Nuclear Station is in use currently and would continue to be used as Lee Nuclear Station Unit 1 was built; a similar system would be used in the Unit 2 excavation. The onsite deep excavation dewatering systems discharge to Make-Up Pond B. Dewatering is expected to be discontinued during operations (Duke 2009c, 2013a).

3.2.3 Structures with a Minor Environmental Interface

The structures described in the following sections would have minimal environmental interface during plant operation.

Nuclear Island and Other Reactor Buildings

Each AP1000 nuclear island would consist of a containment building, a shield building, and an auxiliary building. The foundation for the nuclear island would be an integral basemat that supports these buildings. The steel containment vessel would be completely surrounded by the reinforced concrete shield building and the auxiliary building. The containment foundations would be approximately 40 ft below grade. The construction materials would be reinforced concrete and steel. The shield buildings would be the tallest structures on the site at 229.5 ft above grade (Duke 2012f).

<u>Annex Building</u>

The annex building would be a concrete and steel structure that would rise to a height of approximately 81 ft above grade and provide personnel access to the plant and house plant-support systems and equipment.

<u>Turbine Building</u>

The AP1000 turbine building would be a rectangular, metal-sided, steel column and beam structure oriented with its long axis radiating from the containment structure. It would rise 146 ft above grade. Each turbine building would have a drain system that discharges to a wastewater retention basin connected to the blowdown sump, and a vent system for the condenser and turbine. The wastewater retention basins would be located north of Unit 1 (Figure 3-4, grid reference C2).

Radwaste Building

The AP1000 radwaste facility would be a steel-framed structure that would house the holding and processing systems for low-level liquid radioactive waste and solid radioactive waste. It also would house the collection and processing system for gaseous radioactive waste. Radioactive waste management is described in more detail in Section 3.4.3. Packaged solid wastes and liquid mixed wastes would be stored in the radwaste building until shipment offsite for further processing or disposal. The environmental interfaces for the radwaste treatment facility would be liquid effluent discharges to the blowdown discharge line, gaseous effluent venting, and solid waste handling for offsite shipment.

Diesel Generator Building

Diesel generators would be installed onsite to provide a backup source of power when the normal power source is disrupted. Combustion emissions would be released to the atmosphere from the generators only during emergency operations and periodic testing. Two diesel generators would be located in the AP1000 diesel generator building; ancillary diesel generators would be located in the AP1000 annex building.

Pipelines

A number of pipelines would be installed to convey water and wastewater on the site and to or from offsite municipal facilities. A potable water pipeline from the Draytonville Water Works distribution system would be brought onsite. Draytonville Water Works indicated that 4000 ft of 6-in. water main would be installed offsite to provide a redundant supply path to the Lee Nuclear Station site. This waterline would be installed within the shoulder of SC 329 just north of its intersection with McKowns Mountain Road (Duke 2010h). A sanitary wastewater pipeline would connect site sanitary waste facilities to the Gaffney Board of Public Works wastewater-treatment plant sewer system.

New HDPE pipelines would be constructed to convey raw water from the Broad River to various plant structures and to convey wastewater from the various plant water systems to the discharge structure (Duke 2012b, e). Raw-water pipelines would interconnect the intake structure on the Broad River and all three makeup ponds. Pipelines would also run between Make-Up Pond A and Make-Up Pond B, and between Make-Up Pond B and Make-Up Pond C. Pipelines would run from the cooling towers and from the wastewater retention basins to the blowdown sump, and from the blowdown sump to the discharge structure on Ninety-Nine Islands Reservoir. The locations of these structures and the raw-water pipeline routes are shown in Figure 3-4 and Figure 3-5. The pipeline easements between the site (Broad River and Make-Up Pond B intakes) and Make-Up Pond C would be 150 ft wide, most other pipeline easements would be 75 ft wide, and all would generally be routed adjacent to existing or planned access roads (Duke 2009b, c).

Support, Laydown, and Spoils Areas

Multiple construction support and laydown areas would be established to support fabrication and building activities and might be maintained as laydown areas for future maintenance and refurbishment of the plant. A spoils disposal and stockpile area is located on the south side of the site (Figure 3-4, grid reference B4). Approximately 186 ac north of Rolling Mill Road and south of Little London Creek would be used for offsite spoils disposal and stockpile during Make-Up Pond C construction (Figure 3-5) (Duke 2009b, c).

Parking

Parking areas would be created to support the construction workforce and some parking would be retained for the operating workforce once plant operations begin. Temporary parking areas would be in the vicinity of the plant, support, and laydown areas identified in Figure 3-4. The permanent parking area for the operating workforce would be located immediately south of Units 1 and 2, between the reactor buildings and the switchyard (Figure 3-4, grid reference C2).

Cranes and Footings

A large crane on a concrete footing would be used to erect proposed Units 1 and 2. Other cranes may be used for materials handling and erection of structures.

Miscellaneous Buildings

A variety of small buildings would exist throughout the site to support worker, fabrication, building, and operational needs (e.g., shop buildings, support offices, warehouses, and guardhouses). Some buildings may be temporary and would be removed after the plant begins operation.

3.3 Construction and Preconstruction Activities

The NRC's authority is limited to construction activities that have "… a reasonable nexus to radiological health and safety or common defense and security" (72 FR 57416), and the NRC has defined "construction" within the context of its regulatory authority. Examples of construction (defined at 10 CFR 50.10(a)) activities for safety-related structures, systems, or components include driving of piles; subsurface preparation; placement of backfill, concrete, or permanent retaining walls within an excavation; installation of foundations; or in-place assembly, erection, fabrication, or testing.

Other activities related to building the plant that do not require NRC approval (but may require a Department of the Army permit) may occur before, during, or after NRC-authorized construction activities. These activities are considered to be “preconstruction” activities in 10 CFR 51.45(c) and may be regulated by other local, State, Tribal, or Federal agencies. Preconstruction includes activities such as site preparation (e.g., clearing, grading, erosion control, and other environmental mitigation measures); erection of fences; excavation; erection of support buildings or facilities; building service facilities (e.g., roads, parking lots, railroad lines, etc.); and procurement or fabrication of components occurring somewhere other than the final, in-place location at the proposed site. Further information about the delineation of construction and preconstruction activities is presented in Chapter 4 of this EIS.

This section describes the structures and activities associated with building proposed Units 1 and 2. Table 3-4 provides general definitions and examples of activities that would be performed when building the new units. This section characterizes the activities for the principal structures to provide the requisite background for the assessment of environmental impacts; it is not intended to be a complete discussion of every activity or a detailed engineering plan.

Table 3-4. Descriptions and Examples of Activities Associated with Building the Proposed Lee Nuclear Station Units 1 and 2

Activity	Description	Examples
Clearing	Removing vegetation or existing structures from the land surface	Clearing vegetation from new pipeline corridors, demolishing and removing old buildings from the unfinished Cherokee Nuclear Station
Grubbing	Removing roots and stumps by digging	Removing stumps and roots of vegetation cleared from new pipeline corridor
Grading	Reforming the elevation of the land surface to facilitate operation of the plant and drainage of precipitation	Leveling the site of the reactors and cooling towers
Hauling	Transporting of material and workforce along established roadways	Driving on new access road by construction workers
Paving	Laying impervious surfaces, such as asphalt and concrete, to provide roadways, walkways, parking areas, and site drainage	Paving a parking area
Shallow excavation	Digging a hole or trench to a depth reachable with a backhoe. Shallow excavation may not require dewatering.	Placing pipelines; setting foundations for small buildings
Deep excavation	Digging an open hole in the ground. Deep excavation requires equipment with greater vertical reach than a backhoe. Deep excavation generally requires dewatering systems to keep the hole from flooding.	Excavating to support fabrication of the basemat for the reactor

Table 3-4. (contd)

Activity	Description	Examples
Excavation dewatering	Pumping water from wells or pumping water directly to keep excavations from flooding with groundwater or surface runoff	Pumping water from excavation of base for reactor building
Grouting	Installing low-permeability material in the subsurface around deep excavation to minimize movement of groundwater	Installing a slurry wall around the excavation for the reactor building
Dredging	Removing substrates and sediment in waters or wetlands regulated under the Clean Water Act	Removing sediment from an intake location
Spoils placement	Placement of construction (earthwork) or dredged material in an upland location	Relocating rock and soil excavated from Make-Up Pond B intake area to the onsite upland spoils disposal area near McKowns Mountain Road
Filling of wetland or waterbody	Discharging dredge and/or fill material into waters of the United States, including wetlands	Placing fill material into a wetland to bring it to grade with adjacent land surface
Dredge placement	Placing fill material in areas not designated as wetlands. These materials can come from dredging wetlands or waterbodies.	Placing sediments removed from the river intake area in a U.S. Army Corps of Engineers-approved placement area
Erection	Assembling all modules into their final positions including all connection between modules	Using a crane to assemble reactor modules
Fabrication	Creating an engineered material from the assembly of a variety of standardized parts. Fabrication can include conforming native soils to some engineered specification (e.g., compacting soil to meet some engineered fill specification).	Preparing and pouring concrete; laying rebar for basemat
Vegetation management	Thinning, planting, trimming, and clearing vegetation	Maintaining the switchyard free of vegetation

3.3.1 Major Activity Areas

3.3.1.1 Landscape and Stormwater Drainage

Preparing to build and operate proposed Units 1 and 2 would require land to be cleared and graded for the main reactor buildings and support facilities and additional space for material and equipment laydown areas. The details of the alterations are discussed in the following sections. After the site is graded, a stormwater-drainage system would be created around the facilities to direct stormwater away from the operational areas to existing or new settling basins. Drainage ditches and pipes would route surface water to monitored discharge locations at Make-Up Ponds A and B and the Broad River. Retention ponds would be designed, constructed, and operated as needed to manage runoff in compliance with Clean Water Act provisions relative to stormwater management. Stormwater discharges to waters of the United States would require an NPDES permit from the South Carolina Department of Health and Environmental Control (SCDHEC) (Duke 2009c, 2013a, 2013c).

3.3.1.2 Reactor Buildings and Cooling Towers

Preparing the locations for the power block and cooling towers would be the largest and most complex activity on the site (Figure 3-4, grid reference C2). Deep excavation and extensive fill placement and large-scale fabrication and erection activities would be involved in building the AP1000 units. The cooling towers would require extensive grading, filling, shallow excavation, and fabrication and erection activities. Building the diesel generator facility would involve limited fabrication and erection. Various components would be hauled to the site by railroad and road. Railroads and roads would be built or upgraded on the Lee Nuclear Station site, particularly in the immediate vicinity of Units 1 and 2 and their cooling towers.

3.3.1.3 Excavation Dewatering

A dewatering system already in place from the unfinished Cherokee Nuclear Station Unit 1 excavation has been used for maintenance dewatering. The existing system would be used to continue dewatering deep excavations as needed during construction. Dewatering pumps would be used during construction of the dam foundation for Make-Up Pond C. Shallow excavation for foundations for other buildings and trenching for pipelines are not expected to require dewatering.

3.3.1.4 Broad River Intake Structure

Building the Broad River intake structure would involve some dredging, and isolating the nearshore work area by installing a temporary cofferdam and dewatering the area behind the cofferdam so that excavation and other site preparation could occur in dry conditions. The cofferdam at the Broad River raw-water intake would be constructed using two banks of Z-shaped sheet piles tied together and filled with stone ballast. The cofferdam would be approximately 258 ft long and would extend approximately 75 ft into the river at the narrowest width of the river. Approximately 47,000 yd^3 of soil and partially weathered rock are expected to be removed. Fabrication of the main concrete pump bay structure would occur after excavation to the level needed to construct a base at 497 ft above MSL. Pumps, piping, debris exclusion and screen wash systems, and necessary electrical systems would be installed to create an operational intake structure.

Duration of the river intake construction would be about 20 months. It would take about five months to complete the cofferdam. Following construction, the cofferdam would be removed behind a weighted silt curtain to protect the river from excess silt load during removal. The removal of the cofferdam would take approximately three months (Duke 2010f).

3.3.1.5 Blowdown and Wastewater Discharge Structure

Underground placement of the blowdown and wastewater discharge pipeline would involve some clearing along the easement, shallow excavation, fill, and grading. Dredging at the shoreline behind the cofferdam (approximately 1400 yd^3) and in the Ninety-Nine Islands Dam forebay near the end of the diffuser (approximately 14,400 yd^3) would be required. Placement of the discharge structure would primarily involve installation of prefabricated components: attaching steel braces to Ninety-Nine Islands Dam, and attaching the diffuser pipe to the braces (Duke 2011f, h).

3.3.1.6 Make-Up Pond A

The remains of the existing water-treatment plant would be removed from Make-Up Pond A. The former Cherokee Nuclear Station intake structure in Make-Up Pond A would be partially removed, but part of it would be left in place to provide access to the proposed new Make-Up Pond A intake structure located further offshore (Figure 3-9) (Duke 2012h). To improve flow near the proposed intake structure, existing underwater dikes would be removed and areas of the pond would be dredged. Approximately 53,000 yd^3 of materials would be removed from the pond (Duke 2011h). Construction activities for the Make-Up Pond A intake structure would be similar to those for the Broad River intake structure. A cofferdam would be placed around the site of the proposed intake structure to allow dewatering of the work area, the site would be excavated to the appropriate depth for structure placement, and the concrete structure would be installed. Pumps, piping, screens, and other equipment would complete the system, and the cofferdam would be removed (Duke 2009c). Construction activities for the Make-Up Pond A discharge structure would include cofferdam installation, dewatering, and fill around the discharge structure after it is installed.

3.3.1.7 Make-Up Pond B

Several modifications are planned to Make-Up Pond B to improve water movement between regions of the pond. Approximately 100 ft of an existing cofferdam in the forebay of the pond would be removed and the area on either side of the cofferdam may be dredged, removing approximately 43,300 yd^3 of material. These changes are proposed to enhance water movement at low water levels. Installing the Make-Up Pond B intake structure and its access causeway would involve dredging or excavation of 86,900 yd^3 of material, temporary cofferdam placement and dewatering, and installation of the concrete wet well (Duke 2011h). Building the causeway would require pile driving and placement of rock fill and riprap (Duke 2009c, 2010l). Installation of the discharge structure on the northwest shore would involve cofferdam installation and dewatering, some excavation, placement of piping and concrete, and placement of riprap to protect the concrete box structure from erosion and scour.

3.3.1.8 Make-Up Pond C

Building Make-Up Pond C would require clearing and grubbing approximately 700 ac and building a dam and other water-retaining structures to impound London Creek. The area around the dam foundation would require dewatering (Duke 2009b). Building the dam and associated structures would require approximately 1.6 million yd^3 of fill material that would come from three borrow areas north of London Creek within the footprint of the proposed pond (Duke 2010f). Existing structures in the area to be impounded would be demolished and removed. In addition, existing ponds within the footprint of the proposed pond would be drained and the existing dams removed. The footprint of the existing ponds would be contoured so that the areas would drain as water levels drop in Make-Up Pond C (Duke 2010d). The downstream side of the existing Lake Cherokee Dam would be protected with filter fabric and riprap where its base would be inundated with about 10 ft of water, and the dam's emergency spillway would be improved (Duke 2012j).

Outside the area that would be inundated, clearing, grubbing, grading, and shallow excavation would be the primary construction activities associated with Make-Up Pond C. These activities would occur as access roads and temporary haul roads were built, as borrow and spoils areas were established, and as support structures were built. London Creek would be temporarily diverted while the Make-Up Pond C dam and spillway were built. Once the pond was filled, a log boom would be installed to prevent debris from blocking the spillway (Duke 2012m).

Approximately 2 mi of an existing out-of-service 44-kV transmission line would have to be removed and a new transmission-line ROW would be rerouted around the west side of the impoundment. In addition, about 3 mi of new 6.9-kV power cable would be buried in the same ROW as the water pipelines and access road for the Make-Up Pond C combined intake/discharge structure.

Approximately 0.8 mi of SC 329 near the southwest end of the impoundment would be realigned, and a new bridge would be built over Make-Up Pond C. At the east end of the impoundment, below the proposed outlet, the railroad crossings of London Creek, Little London Creek, and their tributaries would be improved. Both of these transportation system improvements involve clearing, placement of cofferdams and temporary diversion of streams, shallow excavation, grading, and filling. At the rail crossing, two existing 10-ft-diameter culverts would be removed and replaced with a large box culvert. Some fill and ballast placement would likely be used to restore the rail bed. Once the realigned SC 329 roadway and bridge were completed, the old roadway would be removed.

Installing the Make-Up Pond C combined intake/discharge structure would involve clearing, grading, shallow excavation, pile driving, placement of piers for the access bridge to the wet well structure, and placement of the wet well structure itself. The intake/discharge structure would be installed prior to filling, so no in-water work would be required (Duke 2009b).

3.3.1.9 Roadways

Improving or building roads on the Lee Nuclear Station site and associated offsite areas would involve clearing, grading, and paving. Temporary access and haul roads in the Make-Up Pond C area would be cleared and graded.

3.3.1.10 Railroad Lines

Restoring the abandoned railroad spur between the Lee Nuclear Station site and the main Norfolk Southern railroad in East Gaffney would require limited clearing of vegetation and replacement of ballast, ties, and track. Some clearing and grading would be required for the detour of approximately 1300 ft of track around the Reddy Ice Plant east of Gaffney. Below the proposed impoundment for Make-Up Pond C, Duke estimates that 4.7 ac of land would be cleared to improve the railroad crossing of London Creek. London Creek would be diverted temporarily during replacement of the two existing culverts with a larger four-cell box culvert. Engineered streambed material (a mix of rocks, gravel, and sand) would be placed in the bottom of the culvert cell carrying the normal flow of London Creek to create a more natural stream channel bottom (Duke 2009b, 2012j). Clearing, grading, and placement of ballast and track would be required on the Lee Nuclear Station site to extend the railroad spur toward the proposed plant area and to create the rail turnaround north of Make-Up Pond B.

3.3.1.11 Pipelines

Laying pipelines and installing break tanks would occur in several areas on the site and between the Broad River and Make-Up Ponds A, B, and C intakes/discharges (see Figure 3-4 and Figure 3-5). Pipeline and break-tank installation would require the clearing land along the pipeline corridor, shallow excavation (trenching), and backfilling. Supports would need to be installed where the pipelines emerge from the ground to extend over or into the water. As described in Section 3.2.3, most of the pipeline corridors are located adjacent to existing or proposed roadways.

3.3.1.12 Concrete Batch Plant

Erecting the temporary concrete batch plant would occur on a cleared, graded area.

3.3.1.13 Construction Support and Laydown Areas

Establishing and preparing laydown areas would be necessary to stage activities. Prior to and during construction and preconstruction, materials would be brought to the site and stored in laydown areas. Duke expects to clear and grade laydown areas in various locations near the Lee Nuclear Station site and other construction activity areas shown on Figure 3-4 and Figure 3-5. Clearing, grading, and surface preparation of construction support and laydown areas also would be needed offsite near the proposed Make-Up Pond C. Support and laydown areas would be graded relatively level and covered with crushed stone or gravel. Normally only limited vegetation is allowed in laydown areas.

3.3.1.14 Parking

Parking areas would be graded and paved, or surfaced with gravel.

3.3.1.15 Miscellaneous Buildings

Excavating for shallow foundations would be required prior to fabrication and erection of miscellaneous buildings.

3.3.1.16 Switchyard

Grading 21 ac of open land would be required for the proposed 230-kV and 525-kV switchyards, which would be adjacent to each other and located south of proposed Units 1 and 2 (Figure 3-4, grid reference C3) (Duke 2009c). Structures housing electrical switching equipment would be erected, and the switchyard would be fenced.

3.3.1.17 Transmission Lines

Installation of transmission lines would require the removal of trees and shrubs along portions of the transmission-line ROW, movement of construction equipment, shallow excavation for the foundations of the transmission-line towers, erection of towers, and stringing of conductors.

3.3.1.18 Cranes and Crane Footings

Fabrication of footings and erection of cranes would be necessary to erect the larger plant structures.

3.3.2 Summary of Resource Commitments During Construction and Preconstruction

Table 3-5 provides a list of the significant resource commitments of construction and preconstruction. The values in the table combined with the affected environment described in Chapter 2 provide the basis for the impacts assessed in Chapter 4. These values were stated in the ER, and the review team has confirmed that the values are reasonable.

Table 3-5. Summary of Resource Commitments Associated with Proposed Lee Nuclear Station Units 1 and 2 Construction and Preconstruction

Resource Areas	Value	Parameter Description	Reference
All Resource Areas	93 mo (7.75 yr)	Duration of construction and preconstruction activities for two AP1000 units	Duke 2009c
	63 mo (5.25 yr)	Duration of Make-Up Pond C activities	Duke 2010l
Land Use, Terrestrial Ecology, Historic and Cultural Resources (Site and Vicinity)	946 ac	Disturbed area footprint, on site: 619 ac permanently disturbed 327 ac temporarily disturbed	Duke 2013d
	1100 ac	Disturbed area footprint related to Make-Up Pond C. 1050 ac permanently disturbed: 643 ac inundated area and impounding structures 407 ac outside inundated area 50 ac temporarily disturbed outside inundated area	Duke 2013d
Land Use, Terrestrial Ecology, Historic and Cultural Resources (Offsite, Transmission Lines)	32 mi	Total length of new transmission-line corridor	Duke 2007c; 2009c, 2010c
	325 ft	Maximum final corridor width	
Hydrology – Groundwater	522 ft MSL (60 to 70 ft below site grade)	Elevation (excavation depth) to which dewatering of onsite deep excavation would be required	Duke 2013a
Hydrology – Surface Water, Aquatic Ecology	250,000 gpd (174 gpm) (0.39 cfs)	Water supply (maximum) obtained from Draytonville Water District	Duke 2009c
Socioeconomics, Transportation, Air Quality	4510 workers	Peak Units 1 and 2 workforce: peak workforce of more than 4400 workers occurs for approximately 1 yr	Duke 2010l
	4613 workers	Peak project workforce including Make-Up Pond C	Duke 2010l
	114 workers	Peak operations workers during construction and preconstruction period	Duke 2009c, l
Terrestrial Ecology, Nonradiological Health, Socioeconomics	90 dBA	Peak noise level 100 ft from activity or 50 ft from road assuming trucks traveling 55 mph	Duke 2009c
	75 dBA	Worker traffic at shift change, traveling at 55 mph	

3.4 Operational Activities

The operational activities considered in the review team's environmental review are those associated with structures that interface with the environment, as described in Section 3.2.2. Examples of operational activities are withdrawing water for the cooling system, discharging blowdown water and sanitary effluent, and discharging waste heat to the atmosphere. Safety activities within the plant are discussed by Duke in the FSAR portion of its application. The results of NRC's safety review will be documented in its Safety Evaluation Report.

The following sections describe the operational activities, including operational modes (Section 3.4.1), plant-environment interfaces during operations (Section 3.4.2), and the radioactive and nonradioactive waste-management systems (Sections 3.4.3 and 3.4.4, respectively), and summarize the values of resource parameters likely to be experienced during operations in Section 3.4.5.

3.4.1 Description of Operational Modes

The operational modes for the proposed Units 1 and 2 considered in the assessment of operational impacts on the environment (Chapter 5 of this EIS) are normal operating conditions and emergency shutdown conditions. These are considered the conditions under which maximum plant-related water withdrawal, heat dissipation, and effluent discharges occur. Cool down, refueling, and accidents are alternate modes to normal plant operation during which water intake, cooling-tower evaporation, water discharge, and radioactive releases may change from normal conditions. Maximum water withdrawal from the Broad River would occur with both proposed units operating at full power and when the Broad River intake refill subsystem is activated to send water to Make-Up Ponds B or C. Refill operations would be independent of the operational mode of proposed Units 1 and 2, but would be limited by flow in the Broad River and permit conditions.

3.4.2 Plant-Environment Interfaces during Operation

This section describes the activities related to structures with an interface to the environment during operation of the proposed Units 1 and 2.

3.4.2.1 Water Withdrawals and Transfers

Duke has developed and proposed a plan for managing water withdrawal from the Broad River and water transfers between makeup ponds that "… will support operation of Lee Nuclear Station, yet maintain appropriate instream flows in the Broad River during drought conditions."

Duke has requested that the following water-management plan, excerpted verbatim from its NPDES permit application, be incorporated into its NPDES permit conditions (Duke 2011a):

“• To minimize withdrawal of water during low-flow periods, a drought contingency pond (Pond C) will be built to complement existing drought contingency Pond B.

- During normal flow periods on the Broad River (>538 cfs), Duke Energy will withdraw all of its operational water requirements from Ninety-Nine Islands Reservoir through the primary section of the river intake into existing sedimentation Pond A. The primary section of the river intake will have a design intake flow of 98 cfs. Pond A will provide water for plant processes and cooling tower makeup. Based on the historical Broad River flow conditions, Duke Energy anticipates this will be the normal withdrawal scheme employed greater than 95 percent of the time.
- As the Broad River flow drops below 538 cfs and begins to approach 483 cfs, Duke Energy will proportionally withdraw its consumptive water requirements (≤63 cfs) from Ninety-Nine Islands Reservoir and drought contingency Ponds B and C. Pond B will be drawn down first. If Pond B drawdown reaches 30 feet, drawdown from Pond B will cease and water will be withdrawn from Pond C to a nominal drawdown ≤30 feet.
- When Broad River flow is at or below 483 cfs, only non-consumptive cooling water (approximately 23 cfs) will be withdrawn from the Ninety-Nine Islands Reservoir. That water will be returned to the reservoir immediately after use in order to maintain adequate flows in the Broad River. The remaining water needed to operate Lee Nuclear Station (≤63 cfs) will be drawn from drought contingency Ponds B and C. Pond B will be drawn down first. If Pond B drawdown reaches 30 feet, drawdown from Pond B will cease and water will be withdrawn from Pond C to a nominal drawdown ≤30 feet. Based on modeling using worst case droughts over the 85-year period of record, Duke Energy does not anticipate that any additional drawdown will be needed. However, should it be warranted to support station operations during emergency drought conditions, any additional drawdown or other water-management protocols will be performed pursuant to a drought contingency plan to be developed in accordance with the South Carolina Water Withdrawal Law after consultation with appropriate regulatory agencies.
- During the period of July through February, and only when the Broad River flows are above 483 cfs, Ponds B and/or C will be refilled, as needed, by withdrawing water from Ninety-Nine Islands Reservoir through the drought contingency section of the river intake. During this period, the water necessary

to operate the station will also be withdrawn from the Ninety-Nine Islands Reservoir via the primary section of the river intake.

- The drought contingency section of the river intake will have a maximum design intake flow of 206 cfs. However, the actual refill rate will be determined using a flow-sensitive approach to ensure Broad River flows do not fall below 483 cfs due to refill of the drought contingency ponds. Further, regardless of river flows, refilling of Ponds B and C will not occur from March through June, in order to minimize entrainment."

The U.S. Environmental Protection Agency (EPA), in comments on the draft EIS, requested that the following language be incorporated regarding Duke's water-management plan: "Note that the operational conditions in Duke's water-management plan are less stringent than requirements cited at 40 CFR Section 125.84(a) through (e) in EPA's Cooling-Water Intake Structure rule for New Facilities. EPA's approval of an NPDES permit containing any conditions less stringent than those allowed in the rule at Section 125.84 is contingent upon a demonstration that the requested alternative requirements comply with 40 CFR Section 125.85." Actual water withdrawals and discharges would need to meet the conditions of withdrawal and discharge permits issued by SCDHEC as authorized by the EPA.

The remainder of this section describes the water withdrawals and transfers based on Duke's proposed water-management plan, which is the basis for the assessment of impacts of the project as proposed. After issuance of the draft EIS, SCDHEC issued a public notice and Draft NPDES Permit in March 2013 (SCDHEC 2013b), and then issued NPDES Permit No. SC0049140 in July 2013 (SCDHEC 2013a). The NPDES permit includes requirements that the location, design, construction, and capacity of the cooling-water intake structure must comply with 40 CFR Part 125.80 through 125.89 and Section 316(b) of the Clean Water Act. The review team determined that the requirements in the NPDES permit were consistent with the assessment performed by Duke and the independent assessment performed by the review team for the draft EIS.

Broad River Intake Structure

The Broad River would be the primary source of water for cooling and other plant water systems. As described in Section 3.2.2.2, the Broad River intake structure comprises two subsystems: (1) the river water subsystem and (2) the makeup pond refill subsystem (see Figure 3-18). The river water subsystem would supply raw water to Units 1 and 2. It would operate continuously as long as flow in the Broad River meets the consumptive water-use needs and the Federal Energy Regulatory Commission (FERC) minimum continuous flow requirement from Ninety-Nine Islands Reservoir. Under normal operating conditions for both units, two of the four river water subsystem pumps would be running, and the withdrawal rate would be 35,030 gpm (78 cfs). About 2000 gpm (4.5 cfs) would be used for the screen wash system and thus return to the river at the intake location; the remaining 33,030 gpm would be pumped to Make-Up Pond A to serve as the source of water for the CWS and other station

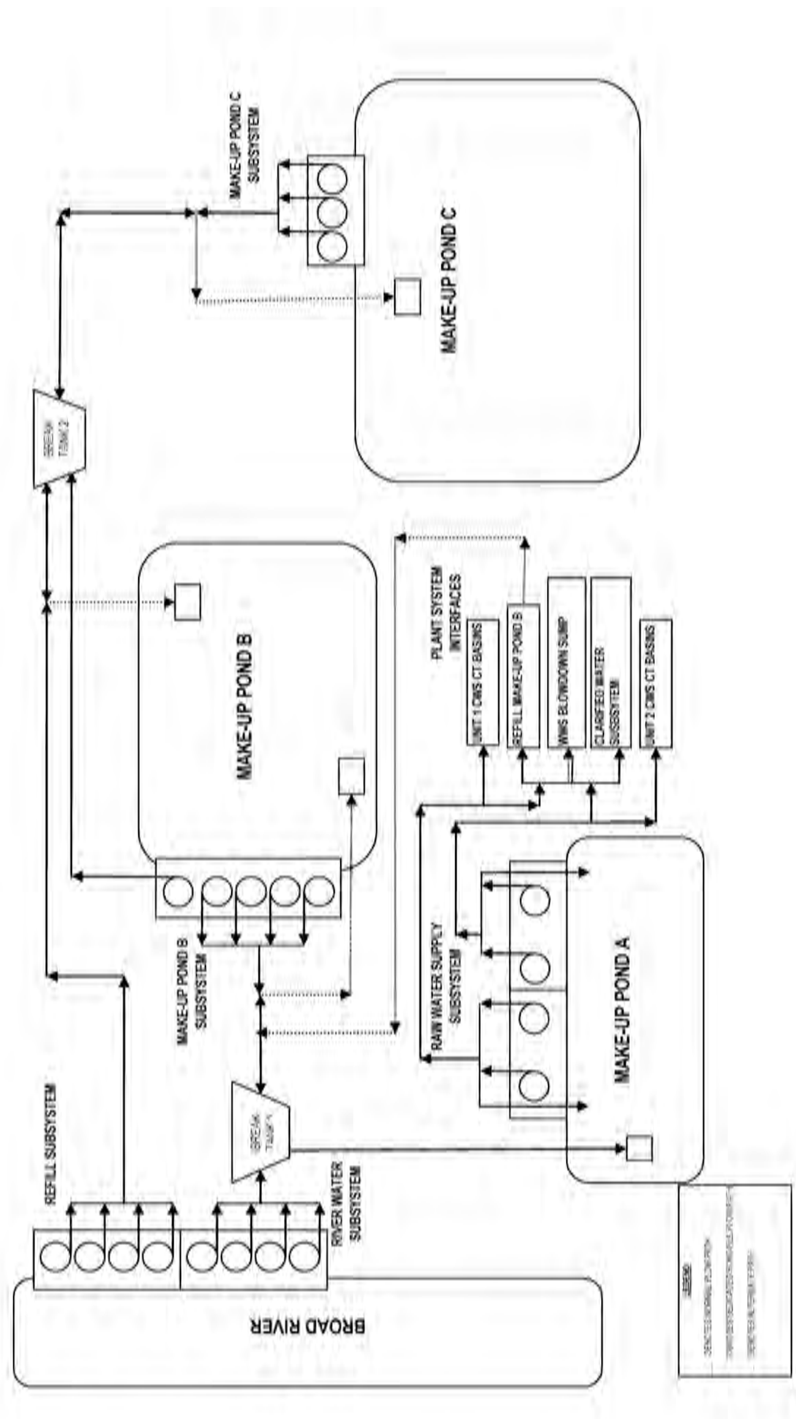

Figure 3-18. Diagram of Water-Supply and Water-Transfer System (Duke 2012h)

water systems (Duke 2009b). Occasionally, one or both standby pumps would be used to maintain the water level in Make-Up Pond A if additional water was being withdrawn to recover the level of Make-Up Pond B, to fill the cooling-tower basins, or for other CWS system maintenance. If all four river water subsystem pumps were operating, the maximum withdrawal rate would be 60,000 gpm (134 cfs).

When flow in the Broad River is unable to meet the consumptive use and the FERC minimum flow requirement, water would be transferred from Make-Up Pond B to Make-Up Pond A, and proportionally less water would be withdrawn from the Broad River, so that Lee Nuclear Station operations would not cause flow in the Broad River to drop below the required minimum release. When flow in the Broad River is at or below the FERC minimum flow requirement, the river water subsystem withdrawal would be limited to the blowdown and screen wash volumes, or about 23 cfs (Duke 2009b, 2010k).

The makeup pond refill subsystem would operate infrequently and intermittently, primarily to refill Make-Up Pond C when its level is low and when river flow and water withdrawal permit conditions allow the additional water to be withdrawn from the Broad River. The refill subsystem also could be used to transfer water directly to Make-Up Pond B. Withdrawal from the Broad River via the refill subsystem (up to four pumps operating) could range up to 92,200 gpm (205 cfs) with 2500 gpm (5 cfs) returning to the river as screen wash water. The remaining 87,900 gpm (200 cfs) would be routed to Make-Up Pond C or Make-Up Pond B as needed to restore the ponds to normal operating levels (Figure 3-18) (Duke 2009b). Refill subsystem withdrawal rates would be variable and intermittent because of the dependence on river flow conditions and consideration of fish spawning periods or seasonal minimum flows.

During operation, the riverbed near the intake structure would need to be dredged periodically; the dredged material would be disposed of at an offsite landfill or reused as beneficial material. Duke estimated the dredged material volume to be approximately 150 yd^3 per year, but also stated that it did not anticipate dredging annually (Duke 2008o, 2012b, j).

Make-Up Pond Intakes, Discharges, and Water Transfers

<u>Make-Up Pond A</u>

Under normal plant operating conditions, three of the four pumps in the Make-Up Pond A intake structure would operate continuously to supply the CWS, SWS, demineralized treatment system, and fire protection systems at a rate of about 33,030 gpm. Occasionally, the standby pump would be used during system maintenance or to refill Make-Up Pond B after Make-Up Pond B had been drawn down to refill Make-Up Pond A during periods when there were limitations on water withdrawal from the Broad River. The maximum withdrawal rate from Make-Up Pond A would be about 57,500 gpm (Duke 2009b, 2012g, h). Duke does not plan to draw down Make-Up Pond A; the water level in Make-Up Pond A would be maintained by transferring water from Make-Up Pond B during low-flow periods when withdrawal from the Broad River is limited. During normal operation, continuous discharge would occur at the Make-Up Pond A discharge structure because Make-Up Pond A is continuously providing water to the station cooling system.

Make-Up Pond B

The intake pumps at Make-Up Pond B would operate only when low-flow conditions limit withdrawal of Broad River water for plant use. As noted above, once Broad River flows drop below the minimum flow requirement, proportionally less water would be withdrawn from the Broad River and proportionally more water would be transferred from Make-Up Pond B to Make-Up Pond A, up to 24,814 gpm (Duke 2009b). Table 3-1 shows that Make-Up Pond B can be drawn down a maximum of 30 ft.

Duke estimated the frequency, magnitude, and duration of Make-Up Pond B drawdown events by applying proposed operational withdrawals for Units 1 and 2 to daily flows in the Broad River over an 85-yr period (January 1926 through December 2010). Duke assumed a minimum continuous flow requirement of 483 cfs plus a 60 cfs allowance for future water demands in the Broad River. In that 85-yr period of record, Duke calculated that Make-Up Pond B would have been drawn down 191 times, and that five of those events would have reached the maximum drawdown of 30 ft (Figure 3-19,Table 3-6) (Duke 2009b, 2011e).

During periods when withdrawal from the Broad River is reduced, the Make-Up Pond B intake pumps would operate continuously to pump water to Make-Up Pond A. Figure 3-20 shows the change in surface area and storage volume as the water level in Pond B is drawn down. Historically, more than 90 percent of Make-Up Pond B drawdown events would have been 5 ft or less and lasted 10 days or less (duration includes time to refill) (Table 3-6).

Duke's longest modeled drawdown event within the capacity of Make-Up Pond B (meaning the event would not have required pumping from Make-Up Pond C) was 22 days, followed by 17 days to refill to its normal elevation of 570 ft above MSL, for a total duration of 39 days (Duke 2009b, 2010k). Maximum drawdown events (more than 30 ft) would have occurred infrequently in Make-Up Pond B, but their duration would have been prolonged, at least 25 days plus time to refill (Table 3-6, Figure 3-20). Maximum drawdown events would require pumping water from Make-Up Pond C to maintain the minimum elevation in Make-Up Pond B. The water level of Make-Up Pond B would be restored as soon as flow and permit conditions allowed withdrawal from the Broad River.

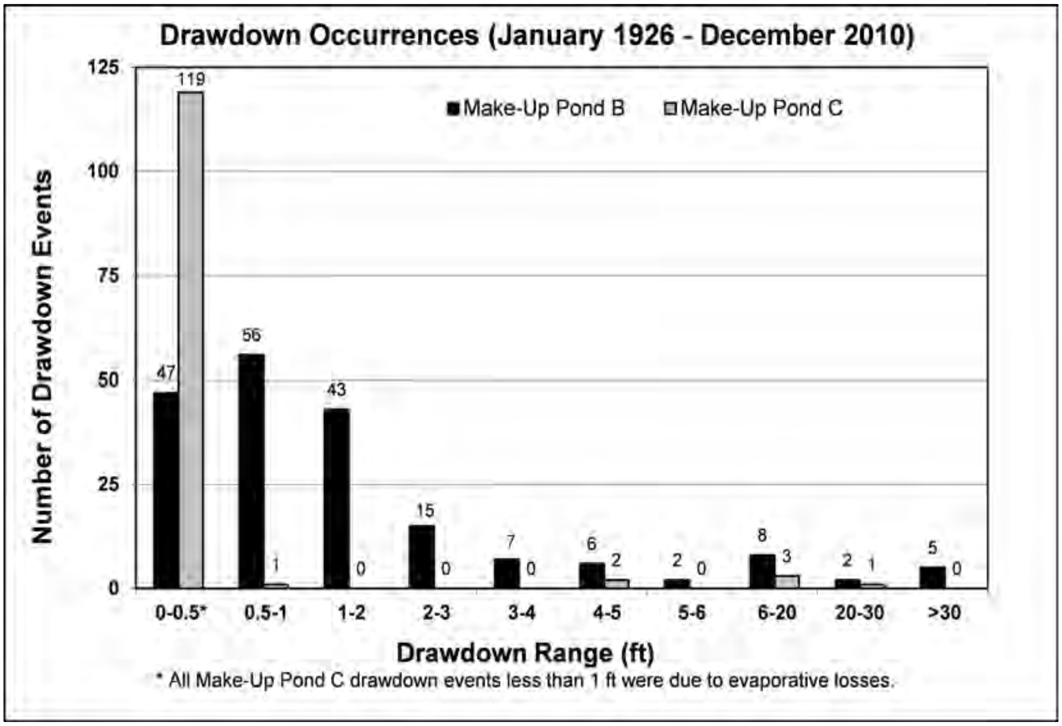

Figure 3-19. Estimated Number of Make-Up Pond Drawdown Events Based on 85-Year Historical Flow Record for Broad River (adapted from Duke 2011a)

Table 3-6. Estimated Frequency, Magnitude, and Duration of Make-Up Pond B Drawdown Events Based on 85-Year Historical Flow Record for the Broad River

Drawdown Range (ft)	Estimated Number of Events	Highest Magnitude Event (ft)[(a)]	Longest Duration Event (days)[(b)]
0–0.5	47	0.5	2
0.5–1	56	1.0	3
1–2	43	2.0	4
2–3	15	3.0	6
3–4	7	3.5	10
4–5	6	4.8	9
5–6	2	5.3	27
6–20	8	17.3	62
20–30	2	21.4	39
>30	5	30.8	139

Sources: Duke 2009b, 2010k, 2011a.

(a) Only the largest drawdown event in Figure 3-19 is shown for each range of drawdown. Magnitudes of drawdown greater than 30 ft are due to evaporation loss when pond has no usable storage.

(b) Duration is sum of days to reach lowest elevation, days at lowest elevation, and days to refill to full pond elevation of 570 ft above MSL, assuming refill begins on the first day that water can be pumped from the Broad River into Make-Up Pond B.

The Make-Up Pond B discharge structure would be used whenever water was pumped in from Make-Up Pond C, and whenever Make-Up Pond B was refilled. Refill events would be associated with each drawdown event, but would be intermittent and variable because of their dependence on Broad River flow conditions. Based on the historical flow record, the duration of refill would typically be up to 2 days for drawdowns of 5 ft or less (91 percent of events), but could be more than 30 days during extended periods of Broad River water limitations (Duke 2009b).

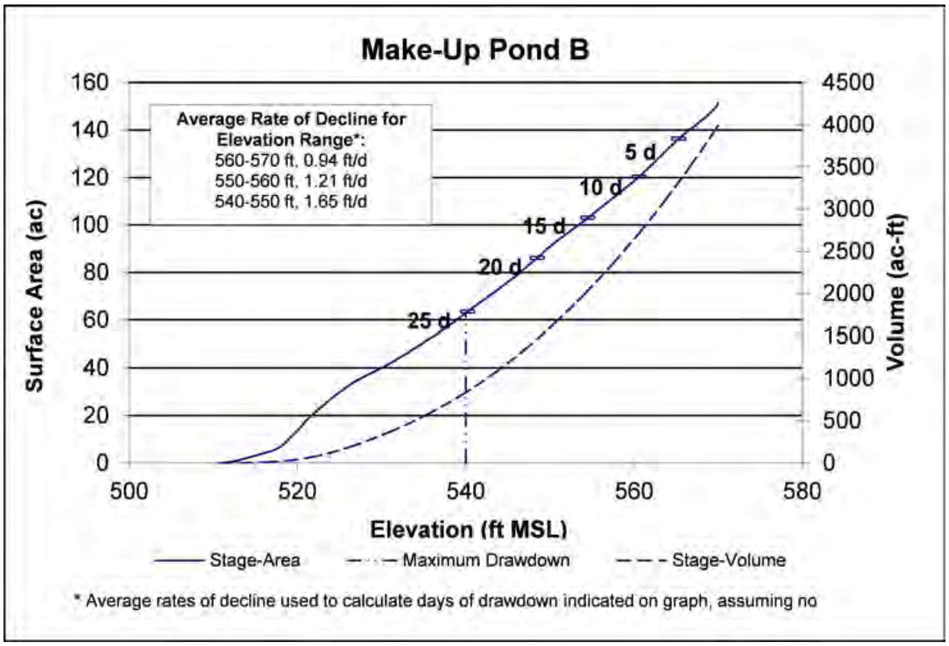

Figure 3-20. Stage-Area and Stage-Volume for Make-Up Pond B, Showing Area at 5, 10, 15, 20, and 25 Days of Transfer to Make-Up Pond A (data sources: Duke 2009b, 2010k)

Make-Up Pond C

The intake pumps at Make-Up Pond C would operate even less frequently than those in Make-Up Pond B. Water would be withdrawn from Make-Up Pond C when low-flow conditions in the Broad River are prolonged to the point that the usable storage in Make-Up Pond B is depleted (Table 3-6). Water would be pumped from Make-Up Pond C to Make-Up Pond B at up to 24,814 gpm (55 cfs) (Duke 2009b). Based on the 85-yr historical record, Duke estimated that water would have been transferred from Make-Up Pond C to Make-Up Pond B five times (Figure 3-19), and that the Make-Up Pond C drawdown would not have exceeded 20 ft during any of those events. Figure 3-21 shows the change in surface area and storage volume as the water level in Make-Up Pond C is drawn down. The discharge portion of the Make-Up Pond C combined intake/discharge structure would only be used during refill operations.

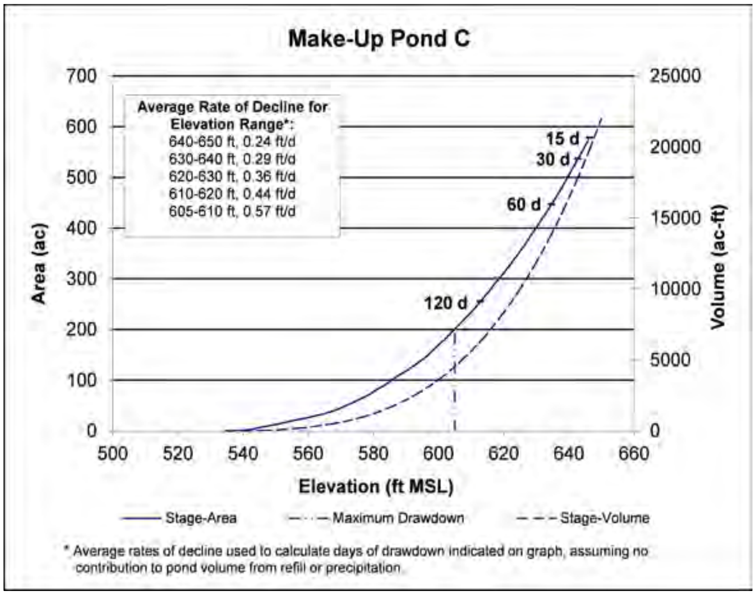

Figure 3-21. Stage-Area and Stage-Volume for Make-Up Pond C, Showing Area at 15, 30, 60, and 120 Days of Transfer to Make-Up Pond B (data sources: Duke 2009b, 2010k)

3.4.2.2 Other Plant-Environment Interfaces During Operation

Cooling Towers

Waste heat is a byproduct of normal power generation at a nuclear power plant. Excess heat in the cooling water would be transferred to the atmosphere by evaporative and conductive cooling in the cooling tower. In addition to evaporative losses, a small percentage of water would be lost in the form of droplets (drift) from the cooling towers, potentially causing visible plumes. Water lost to evaporation and drift is considered consumptive use because the water is not available for reuse. As with water withdrawal, the normal case assumes the cooling towers are operating at four cycles of concentration. The cycles of concentration refers to the number of times that water circulates through the closed-cycle cooling-water system before some of it is discharged as blowdown. This is done to limit the amount of dissolved solids in the water; the number of cycles of concentration is used to calculate the concentration of dissolved solids in the effluent. Duke provided the following typical consumptive use rates (Duke 2009c): CWS normal and maximum evaporation rates would be 24,270 and 28,026 gpm (54 and 62 cfs), respectively; SWS normal and maximum evaporation rates would be 368 and 1248 gpm (0.8 and 2.8 cfs), respectively; and drift rates of 3 gpm for the CWS and 1 gpm for the SWS would not change with the number of cycles of concentration (Duke 2009c). Actual cooling-tower consumptive use rates would vary with atmospheric conditions (temperature and relative humidity). In its analysis of plant water use and pond drawdown, Duke used the monthly consumptive use rates shown in Table 3-7 (Duke 2010k).

Table 3-7. Consumptive Water Use Rates by Month for Proposed Lee Nuclear Station Units 1 and 2

Month	Total Plant Consumptive Use for Two Units (gpm)	Total Plant Consumptive Use for Two Units (cfs)
January	22,846	50.9
February	23,384	52.1
March	24,775	55.2
April	26,122	58.2
May	26,975	60.1
June	27,783	61.9
July	28,276	63.0
August	27,962	62.3
September	27,109	60.4
October	25,763	57.4
November	24,506	54.6
December	23,294	51.9

Source: Duke 2010k.

Discharge Structure

The cooling water that does not evaporate or drift from the towers would be routed back to the cooling-tower basin at the base of each tower. The closed-cycle cooling-water loop is completed when cooled water is pumped from the cooling-tower basins back to the condenser and heat exchangers. Evaporation of water from the cooling tower increases the concentration of dissolved solids in the cooling-water system. To limit the concentration of dissolved solids, a portion of the cooling water would be removed as blowdown and replaced with makeup water. Some waste heat would be removed from the cooling system with the blowdown water. Blowdown water represents 98 percent of effluent discharged to Ninety-Nine Islands Reservoir via the diffuser on the upstream side of the dam. The average blowdown temperature is expected to be 91°F and the maximum blowdown temperature was estimated to be 95°F. Duke estimated the normal CWS blowdown flow rate to be 8087 gpm for both units (maximum 28,023 gpm) and the normal SWS blowdown flow rate to be 121 gpm for both units (maximum 410 gpm). Blowdown from the SWS serves as makeup water for the CWS so it does not contribute to the total volume of water discharged to the reservoir. Discharge from other plant systems including the demineralized water-treatment system, fire protection system, and others would be collected in the wastewater retention basins and discharged with the blowdown yielding discharge to the reservoir of 8216 gpm (18 cfs) under normal operating conditions and maximum discharge to the reservoir of 28,778 gpm (64 cfs) (Duke 2009b).

Power Transmission System

During plant operation, there are potential continuing impacts from electric fields, noise, and corridor maintenance. Duke has established procedures for transmission system inspection and maintenance that include aerial inspections two times per year. Transmission corridors would be maintained to control vegetation using herbicides or mechanical cutting and removal methods where herbicides cannot be applied (Duke 2009c). Routine maintenance activities such as ROW clearing, structure repair and replacement, and other activities are also expected to be consistent with all applicable local, State, and Federal guidelines.

Emergency Diesel Generators

The proposed Lee Nuclear Station Units 1 and 2 would each have two 4000-kW standby generators located in the AP1000 diesel generator building and two 35-kW ancillary diesel generators located in the AP1000 annex building. The backup fire pumps for each unit also are diesel powered. One 750-kW diesel generator would provide backup power to the Lee Nuclear Station technical support center. Combustion emissions from these diesel generators and secondary fire pumps would be released to the atmosphere only during emergency operations and periodic testing. Emissions include particulates, sulfur oxides, carbon monoxide, hydrocarbons, nitrogen oxides, and carbon dioxide (Duke 2009c). Gaseous releases would need to comply with levels permitted by SCDHEC.

3.4.3 Radioactive Waste-Management System

Liquid, gaseous, and solid radioactive waste-management systems would be used to collect and treat radioactive materials produced as byproducts of operating the proposed Lee Nuclear Station Units 1 and 2. These systems would process radioactive liquid, gaseous, and solid effluents to maintain releases within regulatory limits and to levels as low as reasonably achievable (ALARA) before releasing them to the environment. Waste-processing systems would be designed to meet the design objectives of 10 CFR Part 50, Appendix I. Radioactive material in the reactor coolant is the primary source of gaseous, liquid, and solid radioactive wastes in light water reactors such as the AP1000 reactors. Radioactive fission products build up within the fuel as a consequence of the fission process. These fission products would be contained in the sealed fuel rods, but small quantities could escape the fuel rods and contaminate the reactor coolant. Neutron activation of the primary coolant system also would add radionuclides to the coolant.

Prior to fuel load, Duke would develop an Offsite Dose Calculation Manual (ODCM) describing the methods and parameters used for calculating offsite radiological doses from liquid and gaseous effluents. The ODCM also would describe the methodology for calculating gaseous and liquid monitoring alarm/trip set points for release of effluents from Lee Nuclear Station, and would specify the operational limits for releasing liquid and gaseous effluents to ensure compliance with NRC regulations.

The systems used to process liquid, gaseous, and solid wastes are described in the following sections. A more detailed description of these systems for the proposed Lee Nuclear Station Units 1 and 2 is provided in Chapter 11 of the AP1000 DCD (Westinghouse 2011). The liquid and gaseous radioactive effluent source terms for the AP1000 design are provided in Tables 11.2-7 and 11.3-3 of the DCD (Westinghouse 2011).

3.4.3.1 Liquid Radioactive Waste-Management System

The liquid radioactive waste-management system would control, collect, segregate, process, handle, store, and dispose of liquids containing radioactive material such that any discharged liquid effluents are below concentration levels specified in 10 CFR Part 20, Appendix B, Table 2 (Westinghouse 2011). The system would use several process trains consisting of tanks, pumps, ion-exchange systems, and filters, and is designed to handle both normal operations and anticipated operational occurrences. Normal operations would include processing (1) borated reactor-grade wastewater, (2) wastewater from floor drains and other wastes with potentially high-suspended solid content, (3) detergent wastes, and (4) chemical wastes. In addition, the radioactive waste-management system could handle effluent streams that typically do not contain radioactive material but that may, on occasion, become radioactive (e.g., steam generator blowdown as a result of steam generator tube leakage). With two exceptions, liquid effluents processed through the liquid radioactive waste-management system would be discharged to the environment. The exceptions are steam generator blowdown that would normally be returned to the condensate system after processing, and reactor coolant that could be degassed prior to reactor shutdown and returned to the reactor coolant system.

Liquid waste would be discharged in batches with flow rates during discharge controlled to maintain acceptable concentrations when diluted by other nonradioactive liquid effluents, primarily cooling-tower blowdown (Duke 2009c). The diluted liquid radioactive waste would be discharged into the Broad River in accordance with applicable discharge permits. The rate of discharge into the blowdown discharge pipeline would be controlled and monitored to make sure the average annual effluent concentration limits from 10 CFR Part 20 are not exceeded. The calculated dose to the maximally exposed individual (MEI) from liquid effluents is evaluated in Section 5.9.2 of this EIS.

3.4.3.2 Gaseous Radioactive Waste-Management System

The gaseous radioactive waste-management system would collect, process, and discharge radioactive or hydrogen-bearing gaseous wastes. It would be a once-through, ambient-temperature, activated-carbon delay system (Westinghouse 2011). Radioactive isotopes of iodine and the noble gases xenon and krypton are created as fission products within fuel rods during operation. Some of these gases could escape to the reactor coolant system through cladding defects and subsequently decay to stable isotopes, and could be released to the environment via plant ventilation, or captured and then released by the gaseous radioactive waste-management system. In addition, various gaseous activation products, such as argon-41, are formed directly in the reactor containment during operation. The gaseous radioactive waste-management system typically would be active only when gaseous concentrations are measured above a given threshold. Waste gas would flow through a guard bed that removes iodine, oxidizing chemicals, and moisture. From the guard bed, waste gas would flow through two delay beds containing activated carbon that dynamically adsorbs and desorbs the gases, delaying them long enough for significant radioactive decay to occur. The gaseous system would only delay noble gases, not collect them, so if noble gases are measured above a threshold value, the reactor coolant system would be diverted to the liquid radioactive waste-management system that could collect noble gases using the degasifier.

Radioactive gaseous effluents from the gaseous radioactive waste-management system would be discharged through the reactor vent, which would be on the side of the containment building about 183 ft above grade elevation (Westinghouse 2011). Minor discharges and some discharges during accidents could occur through the turbine building vents, such as the condenser air removal stack. At the Lee Nuclear Station, the reactor vent would be at approximately 776-ft elevation, and the turbine building vents would be at approximately 738-ft elevation (Duke 2009c, 2013a). The rate of discharge into the atmosphere would be controlled and monitored to verify that the average annual effluent concentration limits from 10 CFR Part 20 are not exceeded (Duke 2009c). The calculated dose to the MEI from gaseous effluents is evaluated in Section 5.9.2 of this EIS.

3.4.3.3 Solid Radioactive Waste-Management System

The solid radioactive waste-management system would treat, temporarily store, package, and dispose of dry or wet solids. The solid radioactive wastes would include spent ion-exchange resins, deep bed filtration media, spent filter cartridges, dry active wastes, and mixed wastes. The system would be designed to handle both normal operations and anticipated operational occurrences. There would be no onsite facilities for long-term storage or permanent disposal of solid wastes, so the packaged wastes would be temporarily stored in the auxiliary and radwaste buildings prior to being shipped to a licensed disposal facility. The AP1000 solid waste-management system releases no gaseous or liquid effluent directly to the environment. This system discharges effluent through the liquid and gaseous waste-management systems. The expected total annual volume of solid radioactive waste treated and shipped would be 1964 ft^3/yr from each unit (Duke 2009c).

The storage and transportation of used reactor fuel is described in Chapter 6.

3.4.4 Nonradioactive Waste-Management Systems

The following sections provide descriptions of the nonradioactive waste systems proposed for Lee Nuclear Station Units 1 and 2, including systems for chemical (including biocide), sanitary, and other effluents. All discharges to surface waters would be regulated by an NPDES permit that would limit the volume and constituent concentrations. The NPDES permit would be administered by SCDHEC; SCDHEC issued NPDES Permit No. SC0049140 in July 2013 (SCDHEC 2013a).

3.4.4.1 Liquid Waste Management

The expected nonradioactive liquid waste streams include sanitary waste, stormwater runoff, cooling-tower blowdown, water-treatment system effluents, and discharges from floor and equipment drains. At the Lee Nuclear Station site, sanitary waste would not discharge into an onsite effluent stream. Wastewater treatment for discharges from the sanitary and potable water systems will be provided offsite by the Gaffney Board of Public Works. Stormwater runoff would be managed by site grading and paving to direct runoff to Make-Up Pond A, Make-Up Pond B, Hold-Up Pond A, or the Broad River (via retention ponds if necessary to meet NPDES permit water-quality requirements) (Duke 2009c, 2012b, 2013a).

The Lee Nuclear Station plant design consolidates the plant-related nonradioactive liquid effluent streams (other than potable/sanitary waste and stormwater) into a single combined discharge. Nearly all of the liquid effluent volume is blowdown from the CWS cooling towers that is collected in the blowdown sump before being discharged via pipeline into Ninety-Nine Islands Reservoir. The average blowdown discharge rate would be 8087 gpm and the maximum blowdown discharge rate would be 28,023 gpm for both units. The average blowdown water temperature is expected to be 91°F, with a maximum temperature of 95°F (Duke 2009c). About 2 percent of the liquid effluent volume comes from the plant wastewater system (Duke 2009c). The plant wastewater system is designed to manage liquid effluent streams that would contain pollutants from system flushing wastes during startup; oil, grease, and suspended solids from floor drains; corrosion and wear of plant piping and equipment; and liquid waste generated during maintenance or inspection activities. These waste streams, along with discharges from the demineralized-water-treatment system and the fire protection water system, are collected in the turbine building sumps for each unit. Wastewater is pumped from the sumps to an oil separator. Waste oil from the separator is collected in storage tanks and disposed of offsite; the wastewater would be routed to retention basins for settling of solids. As described in Section 3.2.3, the retention basins would be located north of proposed Unit 1 (Figure 3-4). Liquid from the retention basins (125 gpm normal, 990 gpm maximum) would be pumped to the blowdown sump for discharge to the Broad River at the Ninety-Nine Islands Reservoir discharge structure. The total liquid effluent discharge rate at the discharge structure is 8216 gpm or 18 cfs during normal operations.

Chemical constituents naturally occurring in Broad River water would be present in the liquid discharge, concentrated by cooling-water recirculation and losses to evaporation. Mean and maximum constituent concentrations at five routine monitoring stations in the Broad River, using quarterly data collected in 2006, are shown in Table 3-8, along with the concentrations of those constituents that would be projected to occur in blowdown discharge during normal operation assuming four cycles of concentration. The point-of-discharge concentrations as well as diluted concentrations based on low flow and annual mean flow conditions in the Broad River are compared to South Carolina water-quality criteria concentrations in Table 3-8. The effluent could also contain residual concentrations of the chemicals used to treat plant cooling water to maintain optimum operating conditions. These chemicals are injected into the CWS and SWS using a chemical feed system, or added to the clarification system that supplies water to the SWS, demineralized water-treatment system, and fire protection water system. Water-treatment chemicals include biocides, anti-scalants, anti-corrosives, pH adjusters, and silt dispersants. Duke estimates of the amount, frequency of use, and concentrations of chemicals and biocides for the proposed Lee Nuclear Station Units 1 and 2 are provided in Table 3-9 (Duke 2009c). While some variation occurs in chemical treatment to meet particular water-use needs, plant effluents are required to be within NPDES-regulated discharge limits (i.e., 40 CFR Part 423).

3.4.4.2 Gaseous Waste Management

Nonradioactive gaseous emissions would result from testing and operating each nuclear unit's two standby diesel generators, two ancillary diesel generators, and one secondary diesel-driven fire pump. Emissions from the generators and pumps would include particulates, sulfur oxides, carbon monoxide, hydrocarbons, nitrogen oxides, and carbon dioxide (Duke 2009c). These would be discharged through exhaust systems vented to the atmosphere between about 600 and 630 ft elevation. Gaseous emissions from the diesel generators and secondary pumps would not be treated, as operation of the equipment would be infrequent and typically of short duration (for testing). No other sources of nonradioactive gaseous emissions are foreseen at the Lee Nuclear Station site (Duke 2009c, 2013a).

3.4.4.3 Solid Waste Management

Debris from the intake structure trash racks and traveling screens would be collected and disposed of offsite by a contractor at a permitted facility. Other nonradioactive solid wastes, including typical solid waste (e.g., metal, wood, paper), and nonradioactive resins, filters, and sludge would also be disposed offsite by contract in a licensed permitted landfill (Duke 2009c).

Table 3-8. Constituent Concentrations in Liquid Effluent for Proposed Lee Nuclear Station Units 1 and 2

Constituent	Concentration Units	South Carolina CMCs for Freshwater Aquatic Life[a,b]	Concentration in Broad River Near Lee Nuclear Station[c]		Concentration at Point of Discharge[d]	
			Mean	Maximum	Mean	Maximum
Aluminum	mg/L	--	0.163	0.268	0.654	1.07
Arsenic	µg/L	340	0.36	2.18	1.43	8.72
Barium	µg/L	--	19.2	22.4	76.8	89.4
Boron	mg/L	--	<0.1	<0.1	NA	NA
Cadmium	µg/L	0.53	<0.5	<0.5	NA	NA
Chromium	µg/L	--	0.827	1.68	3.31	6.72
Copper	µg/L	3.8	1.31	4.97	5.24	19.9
Iron	mg/L	--	0.855	1.11	3.42	4.42
Lead	µg/L	14	<2	<2	NA	NA
Magnesium	mg/L	--	1.67	1.88	6.68	7.5
Manganese	µg/L	--	47.7	61.9	191	247
Mercury	µg/L	1.6	<0.087	<0.1	NA	NA
Nickel	µg/L	150	0.128	2.95	0.513	11.8
Selenium	µg/L	--	<2	<2	NA	NA
Silver	µg/L	0.37	<0.5	<0.5	NA	NA
Sulfate	mg/L	--	6.26	9.77	25	39.1
Zinc	µg/L	37	5.44	12.6	21.8	50.2

Source: Duke 2009b

(a) CMC=criterion maximum concentration, mg/L = milligrams per liter, µg/L = micrograms per liter, NA = no effluent concentration.
(b) South Carolina Water Classifications and Standards Regulation 61-68 (April 25, 2008) established maximum concentrations for freshwater (CMCs) (SCDHEC 2008a). State water-quality standard maximum concentrations did not change in the 2012 update of Regulation 61-68 (SCDHEC 2012a).
(c) Calculated from quarterly monitoring (February, May, August, November 2006) at five stations within the main channel of the Broad River.
(d) Assumes normal operation at four cycles of concentration, so the mean or maximum analyte concentration in the Broad River is increased by a factor of four. Concentrations were not calculated if the constituent was not detected in the river.
Underlined values exceed CMC value.

Table 3-9. Waste Stream Concentration of Water-Treatment Chemicals from the Proposed Lee Nuclear Station Units 1 and 2

Chemical-Type/Specific	System	Frequency of Use	Concentration in Waste Stream
Biocide/sodium hypochlorite	CWS, SWS	2-4 times per week	Undetectable
Biocide/sodium hypochlorite	Clarifier	Continuous	0.2 ppm
Biocide/sodium bromide	CWS, SWS	2-4 times per week	Undetectable
pH adjustment/sulfuric acid	CWS, SWS, Clarifier	Intermittent	Undetectable
pH adjustment/sulfuric acid	Demineralized Treatment	Intermittent	2.3 to 6.8 ppm
Silt dispersant/polyacrylate	CWS, SWS	Continuous	<10 ppm
Anti-scalant/polyacrylate	Demineralized Treatment	Intermittent	150 to 450 ppm
Dechlorination/sodium bisulfite	Demineralized Treatment	Continuous	Undetectable
pH adjustment/ methoxy-propylamine	Steam Generator Blowdown	Continuous	<9 ppm
pH adjustment/dimethylamine	Steam Generator Blowdown	Continuous	<100 ppb
Oxygen scavenging/hydrazine	Steam Generator Blowdown	Continuous	<100 ppb
Oxygen scavenging/carbohydrazide	Steam Generator Blowdown	Intermittent	<100 ppb

Source: Duke 2009c
ppm = parts per million.
ppb = parts per billion.

3.4.4.4 Hazardous and Mixed Waste Management

Lee Nuclear Station would be classified as a small-quantity generator of hazardous waste, and as such, hazardous waste generated at the Lee Nuclear Station would be temporarily stored onsite and then disposed offsite by a contractor at a licensed permitted facility (Duke 2009c). Hazardous wastes would be managed in compliance with the Resource Conservation and Recovery Act and the South Carolina Hazardous Waste Management Act (SC Code Ann 44-56) requirements. Duke's waste-management practices include separation of wastes to avoid creating mixed waste (i.e., waste containing both radioactive and nonradioactive material); however, any mixed waste would be managed as radioactive waste as described in Section 3.4.3 (Duke 2009c).

3.4.5 Summary of Resource Commitments During Operation

Table 3-10 provides a list of the significant resource commitments that would be involved in operating Units 1 and 2. The values in the table, combined with the affected environment described in Chapter 2 of this EIS, provide a part of the basis for the operational impacts assessed in Chapter 5. These values were stated in the ER, and the review team has determined that the values are reasonable.

Table 3-10. Resource Commitments Associated with Operation of the Proposed Lee Nuclear Station Units 1 and 2

Resource(s)	Value	Parameter Description	Reference
Hydrology-Surface Water, Aquatic Ecology	35,030 gpm (78 cfs)	Normal water withdrawal, plant operations	Duke 2009b
	60,001 gpm (134 cfs)	Maximum water withdrawal, plant operations (not including pond refill)	
	92,200 gpm (205 cfs)	Maximum water withdrawal for periodic pond refill operations	
Hydrology-Surface Water, Meteorology-Air Quality	24,270 gpm 368 gpm	Normal CWS evaporation rate Normal SWS evaporation rate	Duke 2009b
	28,026 gpm 1248 gpm	Maximum CWS evaporation rate Maximum SWS evaporation rate	
Meteorology-Air Quality, Terrestrial Ecology	3 gpm 1 gpm	Normal CWS drift rate Normal SWS drift rate	Duke 2009b
	3 gpm 2 gpm	Maximum CWS drift rate Maximum SWS drift rate	
Hydrology-Surface Water	24,813 gpm (55 cfs)	Normal consumptive water use (all plant systems combined)	Duke 2009b
	29,614 gpm (66 cfs)	Maximum consumptive water use (all plant systems combined)	
Hydrology-Surface Water	8216 gpm (18 cfs)	Normal discharge flow rate to Ninety-Nine Islands Reservoir	Duke 2009b
	28,603 gpm (64 cfs)	Maximum discharge flow rate to Ninety-Nine Islands Reservoir	
Hydrology-Surface Water, Aquatic Ecology	91°F	Average blowdown temperature	Duke 2009k
	95°F	Maximum blowdown temperature	
Terrestrial Ecology, Meteorology-Air Quality	85 ft	CWS cooling-tower height (ground elevation at towers would be 588 ft MSL)	Duke 2012g, 2013a
Terrestrial Ecology	229.5 ft above ground level	Tallest building height (containment)	Duke 2012f
Socioeconomics	957 workers	Normal operating workforce for two units	Duke 2009c
	1757 workers	Maximum workforce during refueling outages lasting 30 days each year (800 temporary workers in addition to the normal workforce)	
Terrestrial Ecology, Nonradiological Health, Socioeconomics	85 dBA	CWS cooling-tower sound level at close proximity	Duke 2009c, 2012g
	55 dBA	CWS cooling-tower sound level at 1000 ft	

Table 3-10. (contd)

Resource(s)	Value	Parameter Description	Reference
Uranium Fuel Cycle, Transportation, Need for Power	3400 MW(t) 3415 MW(t)	Thermal power rating per unit Nuclear steam supply system thermal output per unit	Duke 2009c
	1200 MW(e)	Gross electrical output per unit	
	1117 MW(e)	Net electrical output per unit	
Uranium Fuel cycle, Transportation	93 percent	Expected AP1000 annual capacity factor	Duke 2009c

4.0 Construction Impacts at the Lee Nuclear Station Site

This chapter examines the environmental issues associated with building proposed Units 1 and 2 at the William States Lee III Nuclear Station (Lee Nuclear Station) site as described in the application for combined licenses (COLs) submitted to the U.S. Nuclear Regulatory Commission (NRC) by Duke Energy Carolinas, LLC (Duke). As part of its application, Duke submitted an environmental report (ER) (Duke 2009c), which discusses the environmental impacts of building, operating, and decommissioning proposed Lee Nuclear Station Units 1 and 2, and a Final Safety Analysis Report (Duke 2013a), which addresses safety aspects of construction and operation. Duke subsequently submitted a supplement to the ER that describes impacts related to Make-Up Pond C, which would be an offsite supplemental cooling-water reservoir for the proposed Units 1 and 2 (Duke 2009b).

As discussed in Section 3.3 of this environmental impact statement (EIS), the NRC's authority related to building new nuclear generating units is limited to "… activities that have a reasonable nexus to radiological health and safety and/or common defense and security" (72 FR 57416). Many of the activities required to build a nuclear power plant do not fall within the NRC's regulatory authority and, therefore, are not "construction" as defined by the NRC. Such activities are referred to as "preconstruction" activities in Title 10 of the *Code of Federal Regulations* (CFR) 51.45(c). The NRC staff evaluates the direct, indirect, and cumulative impacts of the construction activities that would be authorized with the issuance of a COL. The environmental effects of preconstruction activities (e.g., clearing and grading, excavation, and erection of support buildings) are included as part of this EIS in the evaluation of cumulative impacts.

As described in Section 1.1.3, the U.S. Army Corps of Engineers (USACE) is working as a cooperating agency on this EIS consistent with the Memorandum of Understanding (MOU) (USACE and NRC 2008). The NRC and the USACE concluded that entering into a cooperative agreement on preparation of this EIS is the most effective and efficient use of Federal resources in the environmental review of impacts associated with building proposed Lee Nuclear Station Units 1 and 2. The goal of this cooperative agreement is to develop one EIS that provides all of the environmental information and analyses needed by the NRC to make a license decision and all of the information needed by the USACE to perform analyses, draw conclusions, and make a permit decision in its Record of Decision documentation. To accomplish this goal, the environmental review described in this EIS was conducted by a joint NRC/USACE review team. The review team was composed of NRC staff, its contractor's staff, and USACE staff.

The information needed by the USACE includes information to perform (1) analyses to determine that the proposed action is the least environmentally damaging practicable alternative

(LEDPA), and (2) its public interest assessment. To perform the public interest assessment, the USACE considered the following public interest factors: conservation, economics, aesthetics, general environmental concerns, wetlands, historic and cultural resources, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply, water quality, energy needs, safety, food and fiber production, and mineral needs. The USACE's public interest assessment is included in Section 9.5.3.

Many of the impacts the USACE must address in its LEDPA analysis are the result of preconstruction activities. Also, most of the activities conducted by a COL applicant that would require a Department of the Army permit would be related to preconstruction. In November 2011, Duke submitted an application to the USACE for a permit to conduct the following activities that may affect waters of the United States, including wetlands: filling, dredging, excavating, grading, removing or destroying vegetation, and building structures (Duke 2011h).

While both the NRC and USACE must meet the requirements of the National Environmental Policy Act of 1969, as amended (NEPA), both agencies also have mission requirements that must be met in addition to their NEPA requirements. The NRC's regulatory authority is based on the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.). The USACE's regulatory authority related to the proposed action is based on Section 404 of the Clean Water Act (CWA) (33 U.S.C. 1251 et seq.), which prohibits the discharge of dredged or fill material into waters of the United States without a permit from the USACE. Therefore, an applicant may not commence preconstruction or construction activities in jurisdictional waters, including wetlands, without a Department of the Army permit. The permit would typically be issued after the USACE's evaluation and public feedback in the form of public comments on its environmental review. Because the USACE is a cooperating agency under the MOU for this EIS, its Record of Decision of whether to issue a permit will not be made until after the final EIS has been issued.

The collaborative effort of the NRC and USACE in presenting their discussion of the environmental effects of building the proposed project, in this chapter and elsewhere, must serve the needs of both agencies. Consistent with the MOU, the NRC and USACE staffs collaborated in (1) the review of the COL application and information provided in response to requests for additional information (RAIs; developed by the NRC and USACE) and (2) the development of the EIS. NRC regulations (10 CFR 51.45(c)) require that the impacts of preconstruction activities be addressed by the applicant as cumulative impacts in its ER. Similarly, the NRC's analysis of the environmental effects of preconstruction activities on each resource area would be addressed as cumulative impacts, normally presented in Chapter 7. However, because of the collaborative effort between the NRC and USACE in this environmental review, the combined impacts of construction activities that would be authorized by the NRC with its issuance of a COL and the preconstruction activities are presented in this chapter. For each resource area, the NRC also provides an impact characterization solely for construction activities that meet the NRC's definition of construction at 10 CFR 50.10(a).

Thereafter, both the assessment of the impacts of 10 CFR 50.10(a) construction activities and the assessment of the combined impacts of construction and preconstruction activities are used in the description and assessment of cumulative impacts in Chapter 7 of this EIS.

For most environmental resource areas (e.g., aquatic ecology), the impacts are not the result of either solely preconstruction or solely construction activities. Rather, the impacts are attributable to a combination of preconstruction and construction activities. However, for most resource areas, the majority of the impacts would occur as a result of preconstruction activities (i.e., development of Make-Up Pond C).

This chapter is divided into 12 sections. In Sections 4.1 through 4.10, the review team evaluates the potential impacts on land use, water use and quality, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological health effects, radiological health effects, and nonradioactive waste. An impact category level – SMALL, MODERATE, or LARGE – of potential adverse impacts has been assigned by the review team for each resource area using the definitions for these terms established in Chapter 1. In some resource areas the impacts may be considered beneficial (e.g., in the socioeconomic area where the impacts of taxes are analyzed), and would be stated as such. The review team's determination of the impact category levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and county governments, such as infrastructure upgrades (discussed throughout this chapter), are implemented. Failure to implement these upgrades might result in a change in the impact category level. Possible mitigation of adverse impacts, where appropriate, is presented in Section 4.11. A summary of the construction impacts is presented in Section 4.12. The technical analyses provided in this chapter support the results, conclusions, and recommendations presented in Chapters 7, 9, and 10 of this EIS.

The review team's evaluation of the impacts of building proposed Lee Nuclear Station Units 1 and 2 draws on information presented in Duke's ER, supplemental documents, the USACE's permitting documentation, and other government and independent sources.

4.1 Land-Use Impacts

This section provides information regarding land-use impacts associated with site-preparation activities and building the proposed Lee Nuclear Station Units 1 and 2. Topics discussed include land-use impacts at the Lee Nuclear Station site and vicinity, at the proposed Make-Up Pond C site, in the proposed transmission-line corridors, and in other offsite areas. No portion of the Lee Nuclear Station project would be located in areas designated as part of the coastal zone. The Broad River Scenic Corridor runs from Ninety-Nine Islands Dam to the confluence of the Pacolet River and is classified as a State Scenic River. Development of the Lee Nuclear Station project is not expected to have any adverse impacts on this 15-mi section of the

Broad River. The Broad River Scenic Corridor is not Federally designated as a National Wild or Scenic River. No part of the project would conflict with zoning laws or with any applicable land-use plans, policies, or controls.

4.1.1 The Site and Vicinity

With the exception of the new transmission lines, the railroad spur, a few offsite road improvements, and the offsite Make-Up Pond C, proposed Lee Nuclear Station Units 1 and 2 and auxiliary facilities would be developed within a 1928-ac site along the Broad River. Additionally, indirect land-use changes in the surrounding landscape, such as new or expanded hotels, could be induced as a result of the need to support construction workers. No zoning laws or regional land-use plans (e.g., comprehensive plans) are in place at the State or County level for unincorporated areas of Cherokee County, including the proposed site (Duke 2009c).

Land-use needs for assessing building impacts at the Lee Nuclear Station site include transportation, grading and cut/fill, spoils and borrow management, laydown areas, utilities, and debris disposal. Figure 3-4 shows the proposed detailed plot plan for the site, including minor design changes subsequent to the draft EIS.

The total area on the Lee Nuclear Station site that would be affected on a long-term basis as a result of permanent facilities at the site is approximately 619 ac, including land to be occupied by the power block, cooling towers, switchyard, wastewater-treatment facilities, pipelines, onsite transmission lines, and general grading and transportation (Duke 2013d). An additional area of approximately 327 ac would be disturbed for temporary construction facilities, including laydown areas and spoils areas (Duke 2013d). The total permanent and temporary footprint on the site would be approximately 946 ac, accounting for only about 49 percent of the total site area. The site therefore appears to be large enough to readily accommodate the proposed footprint with only minimal encroachment on environmentally sensitive land such as wetlands and floodplains.

Approximately 585 ac of the estimated 946 ac of total permanent and temporary land disturbance lies within the 750 ac of land previously disturbed (prior to 1982) for the unfinished Cherokee Nuclear Station project (Duke 2013d). The proposed construction footprint would therefore encompass only about 361 ac of previously undisturbed land on the site. The Lee Nuclear Station would also use existing Make-Up Pond A, Hold-Up Pond A, and Make-Up Pond B, which were all built on the site prior to 1982 for the unfinished Cherokee Nuclear Station project. These ponds presently serve no use.

Additional disturbances at the Lee Nuclear Station site while building the proposed new facilities would include modification and improvement of existing roadways, building a heavy-haul road from the railroad-spur terminal end to the power block, and building of several outbuildings, including administration, security, and process-related facilities. The land-use demands for these activities are accounted for in the estimated land-use acreage data presented earlier in this section. The heavy-haul road would be built within previously disturbed areas.

The existing site entry and proposed primary construction access road would be on the south-central site boundary, off McKowns Mountain Road. Established roadways on the site would be maintained or refurbished for building activities. Building new roadways onsite to support material deliveries and buildings, either temporary or permanent, would largely be confined to previously disturbed areas. The land-use demands for these activities are accounted for in the estimated land-use acreage data presented earlier in this section. Temporary roadways and temporarily altered acreage would be reclaimed to natural vegetative grassland, native shrub, or native forestland as site conditions permit.

Clearing and removal of shrubs, trees, and other vegetation growing in the area of proposed disturbance would be required. The approximately 2 ac of prime farmland in the southeast corner of the site, off of Ninety-Nine Ferry Road, would not be physically disturbed by building the proposed facilities. Finish grading would be used to enhance stormwater movement away from buildings and other facilities. The area excavated for the power block would require dewatering, excavation, and backfilling of material. Existing cooling-water ponds would be dredged to restore depth and to minimize future dredging activity. Spoils material would be taken from the cooling-water ponds and excavations for the power block and switchyard, and be disposed of in designated spoils areas onsite (Duke 2013d). Figure 3-4 shows areas for borrow and spoils storage. The land-use demands for these activities are accounted for in the estimated land-use acreage data presented above.

Other than cutting woody vegetation from approximately 0.21 ac of forested wetlands to accommodate overhead transmission lines, no project activities would take place within jurisdictional wetlands on the Lee Nuclear Station site. However, work performed within Make-Up Ponds A and B, which are designated as waters of the United States, would require approval under the CWA (see Sections 4.3.1 and 4.3.2). Any work that has the potential to affect wetlands or waters of the United States would be performed in accordance with applicable State and Federal regulatory requirements. Ground disturbance to build the cooling-water intake structure and discharge structure would extend into the Broad River floodplain and channel and would comply with all applicable regulatory requirements under the CWA (see additional discussion in Section 4.3.2.1). Other building activities would take place outside the 100-year and 500-year floodplain. No building-related impacts are expected to affect current land uses within the floodplains aside from intake and discharge structures. Additional information regarding hydrological alterations to the Lee Nuclear Station site is in Section 4.2.

Several existing pipelines are maintained in the 6-mi radius vicinity, including one for fiber-optic cable, four natural-gas pipelines, and four liquid-petroleum pipelines. The existing pipeline closest to the Lee Nuclear Station site is approximately 4 mi away and not expected to be affected by building activities.

Based on information provided by Duke and the review team's independent review, the review team concludes that because the land-use demands of the project can be accommodated in only about 49 percent of the site area, because of the ability to minimize encroachment into sensitive environmental lands, because of the past site-development impacts associated with the former Cherokee Nuclear Station project, and because of the absence of zoning restrictions and other land-use conflicts, land-use impacts on the site would be minimal.

4.1.2 The Make-Up Pond C Site

The proposed Make-Up Pond C site encompasses approximately 2110 ac (Duke 2013d) and is located northwest of the Lee Nuclear Station site in the London Creek watershed (Duke 2009b). According to Duke (Duke 2013d), Make-Up Pond C, including the impoundment, dam footprint, saddle dikes, and spillway, would occupy approximately 643 ac of the 2110-ac Make-Up Pond C site. An additional area of approximately 404 ac would be occupied by other permanent features necessitated by Make-Up Pond C, such as spoils disposal, a pump house, realignment of South Carolina Highway 329 (SC 329) and various onsite roadways and other utilities (Duke 2013d). These permanent land commitments total approximately 1047 ac. In addition, Duke has stated that re-routing a transmission line as part of building the new pond would require a permanent commitment of approximately 3 ac of land outside of the 2110-ac Make-Up Pond C site (Duke 2013d). The total permanent land commitment needed to build Make-Up Pond C is therefore approximately 1050 ac.

Besides these permanent land uses, approximately 50 ac of additional land on the roughly 2110-ac Make-Up Pond C site would have to be temporarily disturbed to build the pond (Duke 2013d). The proposed permanent and temporary land uses associated with building Make-Up Pond C would therefore total approximately 1100 ac. Duke has not indicated what it proposes to do with the remainder of the 2110-ac Make-Up Pond C site.

Approximately 86 privately owned housing units have been removed from the Make-Up Pond C site since the acquisition of the land by Duke (Duke 2012b). After Duke purchased the property, it allowed home owners to remain in their homes from 1 to 18 months rent-free and provided relocation services, as needed, for displaced property owners and renters. For homes that were being rented at the time of purchase, Duke usually gave renters between 30 and 90 days' notice to vacate the property (Duke 2009b).

Approximately 260 ac of land designated as prime farmland and farmland of statewide importance occur within the Make-Up Pond C site (Duke 2009b). Even though not all of these lands would be physically disturbed by building Make-Up Pond C and associated facilities, Duke has stated that none of this land would be available for use as farmland over the 40-year operating license period, because access would be restricted (Duke 2009b). The review team's interpretation is that all 260 ac of prime or other special status farmland would be unavailable to agriculture for the foreseeable future.

Based on information provided by Duke and the review team's independent evaluation, the review team concludes that because Duke had to purchase approximately 2110 ac of privately owned land, restrict most uses of that land, and demolish 86 privately owned residences, the land-use impacts related to building Make-Up Pond C would be noticeable. However, because of the abundance of similar agricultural and undeveloped forestland in the vicinity and region, and because displaced occupants of the demolished residences are not likely to have experienced housing shortages in the region, the review team concludes that the impacts would not be destabilizing to regional land-use patterns.

4.1.3 Transmission-Line Corridors and Other Offsite Areas

Other offsite land-use changes in the vicinity of the Lee Nuclear Station site would be expected from installation of the proposed transmission lines and reconstruction of the railroad spur from East Gaffney to the site.

4.1.3.1 Transmission-Line Corridors

In proposing the new transmission-line corridors and associated rights-of-way (ROWs), Duke conducted a discrete and comprehensive transmission-line siting and environmental analysis (Duke 2007c). The fundamental goal of the siting analysis was to enable the selection of two transmission-line corridors that minimized the impacts on land use, environmental resources, cultural resources, and aesthetic quality. In delineating the siting study area, Duke considered the topical influence of several key criteria, including physical geography and topography, the Broad River Scenic Corridor, land-use and development patterns, transportation and infrastructure corridors, and requiring linear segments of the existing Pacolet-Catawba 230-kV line and the Oconee-Newport 525-kV line. Duke clearly indicated a number of areas to be avoided when possible, including agricultural land, residences, historic and cultural landmarks, buildings, parks, and wetlands.

Duke used both internal and external sources of data to characterize the siting area, including local, State, and Federal resources. Additionally, extensive field investigations were conducted to confirm or refute data regarding existing land use, aesthetic, natural, and cultural resources, identifiable development patterns, and infrastructure. Field-specific activity also included community and public workshops conducted in April 2007. Data and attributes were combined into 12 Geographic Information System layers and weighted to assign sensitivity related to transmission-line routing. Weighted data were then combined to form a multilayer map or suitability composite. This allowed for analysis of the cumulative effect of the combined data points and enabled ranking of the siting area from the lowest constraint to the highest constraint in routing, including all points in between.

The geographic area under consideration was approximately 181,420 ac. Within that area, 21 routes were established as meeting criteria for the lowest constraint and impact. The routes, composed of 115 different combinations of potential routes, were verified in field investigations.

In June 2007, the verified alternative routes were presented in follow-up public meetings. The 21 alternative routes were then individually evaluated against eight criteria, including cultural and natural resources, land cover, land use, property ownership, occupied buildings and facilities, public viewshed/visibility, residential viewshed/visibility, and water-quality factors. The two routes that represented the best combination of technical and environmental considerations were determined to be Routes K and O (Figure 2-5).

As a result of the transmission-line study (Duke 2007c) and public meetings, Duke proposes to build four new transmission lines to serve Lee Nuclear Station. As shown in Figure 2-5, this would require building two transmission-line corridors along Routes K and O running south and southwest from the site to their respective tie-in locations on the existing 230-kV Pacolet Tie–Catawba line, located approximately 7 mi south of the site and the existing 525-kV Oconee–Newport line, located approximately 15 mi south of the site.

From the Lee Nuclear Station to the Pacolet Tie–Catawba 230-kV line, both routes would contain one double-circuit 230-kV line and one single-circuit 525-kV line. The transmission-line corridor width would be approximately 325 ft where both the 230-kV and 525-kV lines run in the same corridor. The 230-kV line from the Lee Nuclear Station site stops at the existing Pacolet Tie–Catawba line. The 525-kV line would continue along both routes in a 200-ft-wide corridor approximately 9.47 mi south, where it would tie in to the Oconee–Newport 525-kV line.

The design of the Lee Nuclear Station fold-in lines would meet or exceed all requirements of the National Electrical Safety Code in effect at the time project activities are under way. Towers for the 230-kV and 525-kV lines would be lattice framework, steel structures consisting of direct-embedded foundations at a depth of approximately 12 ft below the ground surface and they would be nominally spaced at 1000 ft.

The most significant land-use impact from building the transmission lines would be the permanent restriction on structures and timber production within the corridors. The estimated acreage affected by the transmission-line corridors is approximately 987 ac; 97 percent of that acreage is not subject to zoning restrictions and is predominantly forest and pasture land. Based on the information available, the review team does not foresee any zoning change or conflict on the remaining 3 percent of land. Section 2.2 described the existing land-use classifications and acreage that would be affected. Approximately 690 ac of forestland would be converted to cleared corridors. Additionally, approximately 163 ac of the proposed corridors are considered prime farmland, or farmland of statewide importance. Duke allows farming and crop production within transmission-line corridors and expects limitations to these conditions related only to where transmission structures are located. Continued permitted uses in the transmission-line corridors would include pastures, crop production, road construction, parking lots, and other uses that do not interfere with the safe, reliable operation of the transmission lines. It is expected that routine or seasonal maintenance would take place outside crop production time frames, which would limit the impact on existing crops (Duke 2007c, 2009c). Approximately 66 ac of transmission-line corridor is within the 100-year floodplain (Duke 2007c). The corridors also encompass streams and 11.17 ac of jurisdictional wetlands (i.e., wetlands regulated under Section 404 of the CWA) (USACE 2013a) (Section 2.4).

Based on information provided by Duke and the review team's independent evaluation, the review team concludes that because approximately 987 ac of land would be affected by transmission-line installation, including the clearing of approximately 690 ac of forested land, the transmission-line-corridor-related impacts would be noticeable. But considering the mostly rural setting for the new transmission lines, the abundance of forestland in that setting, and the ability to build the lines without interfering with most agricultural land use, the review team believes that the effects would not be destabilizing.

4.1.3.2 Railroad Corridor and Offsite Road Improvements

Reconstruction of a railroad spur is planned to support project activities for the proposed Lee Nuclear Station. The spur enters the site on the northern boundary, extends across the northern quarter of the site, and terminates at the project building site. The railroad spur originates in East Gaffney, southeast of the city center. Reconstruction would include placement of new ballast and track and would take place within the existing corridor and previously disturbed areas. Reconstruction of the railroad spur outside the Lee Nuclear Station site boundary would make use of the existing ROW that already has been heavily disturbed due to previous site building activities (Duke 2009c).

A portion of the existing railroad-spur corridor requires routing around an existing industrial facility, Reddy Ice, in East Gaffney. At this location, the ROW passes through the Reddy Ice driveway. The rerouting would extend the railroad spur a maximum of 125 ft to the north of the current ROW and would involve approximately 1300 ft of track. Building the railway at this location and elsewhere would be in accordance with all local, State, and Federal guidelines regarding good engineering and construction practices to minimize the irreversible commitment of land and the impact on the affected environment.

Based on information provided by Duke and the review team's independent review, the review team concludes that land-use impacts related to building the railroad spur would be minimal. The offsite road improvements, which would be limited widening and adding traffic signals to existing roads, likewise involve no more than minimal land-use impacts.

4.1.4 Summary of Land-Use Impacts During Construction and Preconstruction

The review team evaluated the construction and preconstruction activities related to building proposed Lee Nuclear Station Units 1 and 2 and the potential land-use impacts at the site and vicinity, the Make-Up Pond C site, the proposed transmission-line corridors, and the rail corridor. Based on information provided by Duke in its ER (Duke 2009c), the supplement to the ER regarding Make-Up Pond C (Duke 2009b), the *Duke Energy Carolinas Siting and Environmental Report for the William States Lee III Nuclear Station 230 kV and 525 kV Fold-in Lines, Cherokee and Union Counties, SC* (Duke 2007c), Duke's RAI responses updating design information subsequent to the draft EIS (especially a letter dated July 1, 2013 [Duke 2013d]), and the review team's independent evaluation, the review team concludes land-use impacts attributed to construction and preconstruction activities for the proposed Lee Nuclear Station Units 1 and 2 would be MODERATE, but that no mitigation beyond the actions stated would be required. The primary contributors to the impacts involve acquisition and use of a roughly 2110-ac previously undeveloped land parcel for Make-Up Pond C and ROWs for the transmission lines. Preparing the Make-Up Pond C site for future development of the pond and related facilities required purchasing and demolishing 86 privately owned residences, purchasing approximately 2110 ac of privately owned land, and permanently inundating or otherwise altering approximately 1050 ac of previously undisturbed rural land. Developing the transmission lines would require clearing approximately 690 ac of mostly forested land.

NRC-authorized construction activities represent only a portion of the analyzed activities (and do not include development of the transmission lines or Make-Up Pond C). The NRC staff concludes that the land-use impacts of NRC-authorized construction activities, which would be confined to the Lee Nuclear Station site, would be SMALL. The NRC staff concludes that no further mitigation, beyond Duke's commitments, would be warranted.

4.2 Water-Related Impacts

Water-related impacts involved in building a nuclear power plant are similar to impacts that would be associated with the development of any large industrial site. Prior to initiating onsite activities, including any site-preparation work, Duke would be required to obtain the appropriate authorizations regulating alterations to the hydrological environment. Below is a list of the water-related authorizations, permits, and certifications potentially required from Federal, State, regional, and local agencies; additional detail is provided in Appendix H.

- <u>CWA Section 401 Water Quality Certification</u>. This certification would be issued by the South Carolina Department of Health and Environmental Control (SCDHEC). This certification is required before the NRC can issue a COL to Duke.
- <u>CWA Section 402(p) National Pollutant Discharge Elimination System (NPDES) Permit</u>. This permit would regulate limits of pollutants in liquid discharges to surface water. The

U.S. Environmental Protection Agency (EPA) has delegated the authority for administering the NPDES program in South Carolina to the SCDHEC, which issued the permit (SC0049140) on July 17, 2013, effective September 1, 2013. A stormwater pollution prevention plan (SWPPP) would also be required.

Hydrologic alterations are discussed in Section 4.2.1; water-use impacts are discussed in Section 4.2.2; water-quality impacts are discussed in Section 4.2.3; and water monitoring is discussed in Section 4.2.4. The section draws from material presented in Duke's Revision 1 and Supplement to Revision 1 of the ER (Duke 2009c).

4.2.1 Hydrological Alterations

Activities associated with building the proposed Lee Nuclear Station Units 1 and 2 are described in detail in Section 3.3. Many of these activities would affect surface water and underlying aquifers on and near the site. Affected surface waterbodies include the Broad River and Ninety-Nine Islands Reservoir, London Creek and its tributaries, small streams that flow across the site, and the existing onsite storage ponds (i.e., Make-Up Pond A, Make-Up Pond B, and Hold-Up Pond A). The Lee Nuclear Station site is located on the unfinished Cherokee Nuclear Station site. Significant hydrological alterations that occurred while building Cherokee Nuclear Station would reduce the magnitude of additional alterations when building the Lee Nuclear Station. The additional hydrological alterations would result from removal of Cherokee Unit 1 infrastructure, removal of bedrock for proposed Lee Nuclear Station Units 1 and 2, temporary excavation dewatering, removal of surface soil to expand the switchyard area, and finish grading to develop stormwater drainage paths.

Building the intake and discharge structures would include dredging in the Broad River and Ninety-Nine Islands Reservoir, with anticipated short-term localized degradation in water quality. Dredged material disposal would be in an onsite spoils area (Duke 2013d). Dredging and dredged material disposal activities would comply with USACE permit requirements. Some dredging for removal of sediment would be required for placing the Broad River intake structure and the Make-Up Pond A intake structure. Cofferdam installation, excavation, and filling would be required at the Make-Up Pond B intake structure. The intake structure would be built in compliance with the Department of the Army permit and should not have long-term impacts on water quality.

Building the discharge system would include laying underground pipeline from the blowdown sump and wastewater-treatment system to Ninety-Nine Islands Dam. The ground cover disturbance and excavation activities would include erosion-control measures. The discharge pipe would be attached to the upstream side of Ninety-Nine Islands Dam. Steel braces would be used to attach the discharge pipe to the dam 10 ft below the minimum pool water level (Duke 2009c, Duke 2012e). Sediment in the dam forebay near the diffuser would be dredged to enhance mixing later during operation (Duke 2011f).

The existing Make-Up Pond A would be dredged to improve flow near the proposed intake structure. Dredging activities would comply with the Department of the Army permit; dredged material disposal would be in an onsite spoils area (Duke 2013d).

Building Make-Up Pond C would alter London Creek. While building of Make-Up Pond C is under way, the London Creek flow would be allowed to pass through sediment settling structures and pipes to downstream of the Make-Up Pond C dam. During the transition period between construction and pond filling, when the pipes would be sealed, pumps would be used to meet the proposed minimum flow releases downstream of the dam (Duke's December 3, 2012 letter). With the filling of the Make-Up Pond C, Duke would release minimum seasonal flows from Make-Up Pond C to London Creek downstream of Make-Up Pond C dam that would be protective of downstream aquatic resources. The minimum seasonal flow rates for January through April would be 1.50 cfs, for May, June, and December 1.0 cfs; and for July through November 0.75 cfs (Duke 2012m). In addition, once the pond was filled, some flow in London Creek downstream of the dam would be expected to resume, fed by dam seepage, groundwater, and runoff from the dam face (Duke 2009b). Groundwater levels in the vicinity of Make-Up Pond C would rise due to leakage from the pond.

Upgrading of the railroad spur to the Lee Nuclear Station site includes improvement of the London Creek and Little London Creek crossings, which involves temporary placement of cofferdams and diversion of streams (Duke 2009b). Erection of transmission-line towers near water or wetlands would be conducted in accordance with SCDHEC erosion-control requirements and NPDES permits.

Onsite groundwater would not be used during building activities for proposed Lee Nuclear Station Units 1 and 2, but it would be affected as a result of those activities. Conditions and activities that could affect groundwater levels and alter groundwater flow at the Lee Nuclear Station site include final site grading, changes to recharge due to impervious surfaces and stormwater basins, and dewatering during excavation (Duke 2009c).

In summary, the hydrological alterations associated with building activities on and in the vicinity of the Lee Nuclear Station site would be due to dredging for the intake and discharge structures in the Broad River and to improve circulation in Make-Up Pond A, building Make-Up Pond C, upgrading railroad-spur crossings over creeks, site grading, changes to runoff and infiltration characteristics, and dewatering in construction areas. Offsite hydrological alterations would be associated with the proposed new or expanded transmission-line corridors where they cross wetlands or surface waters. The impacts of hydrological alterations resulting from both onsite and offsite activities would be localized and temporary. Compliance with the requirements of the permits, certifications, and SWPPP, including implementation of best management practices (BMPs) would minimize impacts.

4.2.2 Water-Use Impacts

This section includes identification of the activities associated with building proposed Lee Nuclear Station Units 1 and 2 that could affect water use, and analysis and evaluation of proposed practices to minimize adverse impacts on water use by these activities. The impacts on the use of surface water and groundwater are discussed in Sections 4.2.2.1 and 4.2.2.2, respectively. Information in this section is drawn from the ER and supplemental information provided by Duke (Duke 2009b, c, Duke 2010f, h, 2011a, e).

4.2.2.1 Surface-Water-Use Impacts

Water needs for building activities at the site would be similar to typical uses of water for large industrial projects. These uses include dust abatement, concrete mixing, and potable water needs. Peak water needs during building activities are estimated to be 250,000 gpd (174 gpm) (Table 3-5). Water would be obtained from Draytonville Water District. The water district obtains its water from the City of Gaffney, South Carolina, which obtains its water from Lake Whelchel and the Broad River. Lake Whelchel is fed by Cherokee and Allison Creeks and water is occasionally pumped into Lake Whelchel from the Broad River (GBPW 2009).

The impacts of construction and preconstruction activities on surface water would be of limited duration. Peak water demands would represent a small portion of the available water from the Draytonville Water District (GBPW 2009; Duke 2010h). Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that the impacts on surface-water use during construction and preconstruction activities for the proposed Lee Nuclear Station Units 1 and 2 would be SMALL, and no mitigation would be warranted. NRC-authorized construction activities represent only a portion of the analyzed activities, therefore the NRC staff concludes that the impacts of NRC-authorized construction activities would be SMALL, and no mitigation measures would be warranted.

4.2.2.2 Groundwater-Use Impacts

Duke has indicated that groundwater would not be used as a water-supply source during building at the Lee Nuclear Station site (Duke 2009c) or Make-Up Pond C site (Duke 2009b). As such, the review team determined that the influences on groundwater while building Lee Nuclear Station and Make-Up Pond C would be from dewatering of excavations at both the site and the pond, and from filling Make-Up Pond C prior to beginning operation of the proposed units.

Building at the Lee Nuclear Station site would involve maintaining a dewatered excavation, removing some additional bedrock within the nuclear island footprint (i.e., deepening the existing excavation), and backfilling the excavated area between proposed Units 1 and 2 (Duke 2009c). Because backfilling would continue, the water table drawdown would decrease, the dewatering product would decrease, and the water table would reach a state of equilibrium with its surrounding aquifer. Building at the site of proposed Make-Up Pond C would require dewatering of the dam foundation and abutment areas (Duke 2009b). Building the intake/discharge structure at Make-Up Pond C and the pipeline from the Broad River to Make-Up Pond C would involve conventional trenching.

Dewatering activities at the Lee Nuclear Station site would continue at the excavation created during the unfinished Cherokee Nuclear Station construction. As discussed in Section 2.3.1.2, the recent excavation dewatering effort produced an average of 0.39 cfs (250,000 gpd) through March 2007. Dewatering of the proposed site would use a combination of dewatering wells located outside of the excavation and sumps with submersible pumps within the excavation. Water from excavation dewatering would be discharged to Hold-Up Pond A before discharging to the Broad River. A similar system was used when building the unfinished Cherokee Nuclear Station units.

Duke assessed the areal extent of dewatering impacts using historical groundwater measurements (see Figure 2-11) and a dewatering analysis. The region affected by drawdown was roughly circular (approximately 1700-ft radius of influence) but irregular in shape. As noted in Section 2.3.1.2, it is possible that along the northeast shore of Make-Up Pond B and in the vicinity of well MW-1200 (see Figure 2-10), groundwater originating from Make-Up Pond B is being drawn to the excavation dewatering sump. A groundwater divide may exist at this location between Make-Up Pond B and well MW-1200; however, the review team interprets the groundwater monitoring data to be inconclusive. Elsewhere, groundwater flow directions appear unchanged away from the excavation; that is, groundwater flows off the high ground to the south of the excavation toward the excavation and from the perimeter of the locally affected region surrounding the excavation toward Hold-Up Pond A and Make-Up Ponds A and B. The review team concludes that Make-Up Pond B drawdown, if caused by excavation dewatering while building the proposed Lee Nuclear Station, would be temporary and influenced by the seasonal water balance within its surrounding watershed. Such a drawdown would not affect offsite water resources.

Duke also evaluated the potential effect of groundwater well drawdown at the Lee Nuclear Station site using a methodology for estimating the radius of influence of dewatering wells. Duke estimated the radius of influence as being well within the site boundaries and relatively far from offsite wells (Duke 2009c). The review team performed an independent check of this calculation and confirmed Duke’s analysis. As described in Section 2.3.1.2, from a groundwater hydrology perspective, the Lee Nuclear Station site is bounded on the west by Make-Up Pond B, on the north by the Broad River, and on the east by the floodplain of the Broad River and Make-Up Pond A. The nearest offsite residential groundwater supply well is located approximately 5000 ft south of the nuclear island and the influence of dewatering drawdown is estimated to extend approximately 1700 ft. Because the original excavation dewatering (i.e., circa 1977 to 1985) required a similar dewatering depth and methodology compared to the proposed excavation dewatering, the review team concludes that the original dewatering activity provides field data indicative of the response of the aquifer to dewatering for the proposed structures. The review team concludes that any impact on the Lee Nuclear Station site groundwater resource as a result of dewatering would be of limited magnitude, localized, and temporary, and therefore minor. Impact on offsite groundwater resources from dewatering would be virtually undetectable.

As described early in this section, building at the proposed Make-Up Pond C site would require dewatering of the dam foundation and abutments area and building the intake/discharge structure. Installation of the onsite/offsite pipeline from the Broad River to Make-Up Pond C would involve conventional trenching. Sediment and rock permeability in the vicinity of the proposed Make-Up Pond C dam and abutments is assumed to be similar to values found at the Lee Nuclear Station site. Accordingly, once the dam foundation area is dewatered, it is anticipated that dewatering flow will reduce to the rainfall that collects in the excavation combined with groundwater inflow (Duke 2009b). Because of the relatively low permeability of the materials, dewatering drawdown is expected to be localized to the immediate vicinity of the excavation.

Upon completion of Make-Up Pond C, groundwater levels would rise in the vicinity of the impoundment area and come into equilibrium with the full-pond level of the pond (Duke 2010f). Within the London Creek watershed, but above the full-pond level of Make-Up Pond C, the groundwater would remain substantially unaffected by the pond. The region that will exhibit the greatest change is the dam, its abutments, and the surrounding region. Groundwater in and around these earthen structures would establish a phreatic surface in equilibrium with the full-pond pool behind the dam, the low-permeability earthen embankments and underlying rock foundation, and the permeability of the natural environment below the dam. Groundwater flow through the earthen structures and surrounding natural materials would feed the stream below the dam.

During site characterization, Duke (2009b) identified one residential potable groundwater well within the Make-Up Pond C inundation area. It, and any other wells discovered within the inundation area during the building of Make-Up Pond C, will be decommissioned and closed in accordance with SCDHEC regulations. Duke acknowledged that potable water groundwater wells located near proposed Make-Up Pond C may exhibit increased water levels due to the filling of Make-Up Pond C.

Based on the absence of groundwater use and the factors discussed above, the review team concludes the overall groundwater impacts from construction and preconstruction activities for the proposed Lee Nuclear Station Units 1 and 2 and Make-Up Pond C would be of limited magnitude, localized, and temporary, and therefore SMALL and no mitigation would be warranted. Based on the above analysis, and because NRC-authorized construction activities represent only a part of the analyzed activities; the NRC staff concludes that impacts on groundwater use from NRC-authorized construction activities would also be SMALL and no mitigation would be warranted.

4.2.3 Water-Quality Impacts

The water-quality impacts of building a nuclear power plant are similar to those associated with the development of any large industrial site. This section includes identification of the activities associated with building the proposed Lee Nuclear Station Units 1 and 2 that could affect surface and groundwater quality, and analysis and evaluation of proposed practices to minimize adverse impacts on water quality by these activities. The impacts on surface water and groundwater are discussed in Section 4.2.3.1 and Section 4.2.3.2, respectively.

4.2.3.1 Surface-Water-Quality Impacts

The activities associated with building proposed Lee Nuclear Station Units 1 and 2 would occur close enough to Ninety-Nine Islands Reservoir their impacts on the quality of surface water need to be considered. The hydrological alterations associated with building the proposed units, including intakes and discharges, as described in Sections 3.3 and 4.2.1, would generally affect surface-water quality by dredging and erosion. Building Make-Up Pond C involves clearing and grubbing, excavation for the dam and abutments, and other activities as described in Section 3.3.1. These activities could result in erosion and sediment and dissolved solids entering the Broad River from the London Creek drainage. The above activities would be regulated by a combination of NPDES and Department of the Army permitting, adoption of a SWPPP, and use of BMPs (for example using cofferdams and silt fences). Installation of the discharge structure within the Federal Energy Regulatory Commission (FERC) Project Boundary Line also requires FERC approval. All necessary mitigation measures required to prevent and/or minimize erosion, sediment and dissolved solids from entering the Broad River will be under the jurisdiction of the FERC.

Activities related to road and railroad-spur improvement could potentially affect water quality in London Creek or other small creeks as land clearing and grading increase the potential for runoff and erosion. Stormwater runoff and water from excavation dewatering in the immediate vicinity of proposed Units 1 and 2 would be managed to drain into Make-Up Pond A, Make-Up Pond B, and the Broad River at permitted outfalls. Duke would use BMPs for soil erosion controls and comply with applicable regulations designed to prevent stormwater runoff from affecting the water quality in the Broad River and small streams in the vicinity of the site (Duke 2009b, c).

New transmission lines would need to be installed. Tower and line installation activities would comply with State and Federal guidelines and BMPs would be used to minimize impacts on water quality from erosion and sedimentation.

Because the impacts of hydrological alterations resulting from activities associated with building the proposed units would be localized and temporary, and because the required permits, certifications, and the SWPPP call for the implementation of BMPs to minimize impacts, the review team concludes that the impacts on surface-water quality from activities related to construction and preconstruction of proposed Lee Nuclear Station Units 1 and 2 would be SMALL, and no further mitigation beyond the actions stated would be warranted. NRC-authorized construction activities represent only a portion of the analyzed activities, therefore the NRC staff concludes that the impacts of NRC-authorized construction would be SMALL, and no further mitigation measures beyond the BMPs discussed above, would be warranted.

4.2.3.2 Groundwater-Quality Impacts

Based on a review of activities that would take place during the building of proposed Lee Nuclear Station Units 1 and 2 and Make-Up Pond C, the review team determined that the impacts on groundwater quality would arise from (1) filling proposed Make-Up Pond C, (2) discharge of groundwater dewatering product, (3) the stormwater management system, and (4) spills. As discussed in Section 4.2.2.2, groundwater would not be used as a water-supply source when building at the Lee Nuclear Station site or Make-Up Pond C site (Duke 2009b, c) and there would be no discharges to the groundwater environment during the building period.

Saturation of the sediment profile during initial filling of Make-Up Pond C can be expected to result in some dissolution of minerals/metals; however, groundwater quality in wells located near the site of proposed Make-Up Pond C is expected to be similar to that observed at the Lee Nuclear Station site and in the region (see Section 2.3.3.2). During the filling process, water will be pumped from the Broad River and discharged into Make-Up Pond C, which could result in elevated levels of turbidity and suspended solids, both from the water source and erosion and suspension of surface soils at the Make-Up Pond C site. Turbidity and suspended solids levels are expected to improve as inorganic particles settle and organic matter is broken down by microbial activity. Based on the filtering provided by the subsurface environment, the review team determined that any changes to the groundwater quality of wells adjacent to Make-Up Pond C would be minor and temporary.

Dewatering of excavations would occur at both sites, (i.e., Lee Nuclear Station and Make-Up Pond C). Ultimately, the dewatering product would discharge to the Broad River at both locations. As discussed above and in Section 2.3.3.2, groundwater in the region includes concentrations of naturally occurring metals as well as pH outside acceptable secondary EPA Drinking Water Standards (40 CFR Part 143). Groundwater of this quality naturally discharges to the Broad River and its tributary streams. The estimated volume of dewatering product from the Lee Nuclear Station site is relatively low compared to the flow of the Broad River (see Section 2.3.1.2). Discharge of dewatering product at both sites would be monitored in accordance with an approved SWPPP prepared by Duke in compliance with an NPDES permit issued by the SCDHEC. The review team concludes that the dewatering product has a naturally occurring quality, is of small volume, is monitored in accordance with an NPDES permit, and would quickly dilute in the Broad River. The review team also concludes that alteration of groundwater quality from other stormwater management system discharges (e.g., to Make-Up Ponds A or Make-Up Pond B) would be undetectable.

BMPs would be applied to prevent spills and minimize their effects. The Spill Prevention, Control, and Countermeasure Plan (SPCCP) required by the SCDHEC pursuant to 40 CFR Part 112 would mitigate impacts on local groundwater because spills would be quickly attended to and not allowed to reach groundwater. Examples of materials that may spill during the building of proposed Lee Nuclear Station Units 1 and 2 are diesel fuel, hydraulic fluid, and lubricants.

Because the impacts of filling proposed Make-Up Pond C, and because spills would be localized, temporary, and of limited magnitude, the review team concludes the construction and preconstruction impacts of the proposed action on groundwater quality would be of limited magnitude, localized, and temporary, and therefore SMALL and no further mitigation other than BMPs would be warranted. Because NRC-authorized construction activities represent only a part of the analyzed activities, the NRC staff concludes that impacts on groundwater-quality from NRC-authorized construction activities would be SMALL and no mitigation other than BMPs would be warranted.

4.2.4 Water Monitoring

Duke outlines monitoring programs for hydrological and chemical monitoring in Sections 6.3 and 6.6 of its ER for proposed Lee Nuclear Station Units 1 and 2 (Duke 2009c).

4.2.4.1 Surface-Water Monitoring

The SCDHEC requires NPDES permitting for projects that disturb more than 1 ac of land. The NPDES permit for construction activities covers the monitoring of stormwater discharges from the areas associated with building the proposed units. To obtain an NPDES permit a SWPPP would be required. The SWPPP would include a description of visual inspection actions to detect erosion and provide effective sediment control, especially after rains. The SWPPP also would include a description of sediment-control BMPs. The approval of the SWPPP precedes the issuance of the NPDES permit, which would typically describe the monitoring locations and frequency. Duke also anticipates monitoring turbidity in the Broad River downstream of dredging activity.

4.2.4.2 Groundwater Monitoring

Some existing groundwater monitoring wells completed during site characterization would likely be abandoned when building at the Lee Nuclear Station site and Make-Up Pond C site because of their location within the proposed action footprint. However, these wells would be replaced with wells at new locations, and all wells would be monitored monthly during site clearing and building activities. The monitoring well network would be used to (1) monitor dewatering and other site clearing and building activities for drawdown during construction; (2) verify design assumptions related to the future hydrostatic loading of the completed structures; (3) document the stabilization of the water table following completion of site clearing and building activities and discontinuance of dewatering; and (4) provide the basis for design of the operational groundwater monitoring program (Duke 2009c).

4.3 Ecological Impacts

This section describes the potential impacts on terrestrial and aquatic ecological resources from construction and preconstruction activities at the Lee Nuclear Station site, creation of a new cooling-water reservoir (Make-Up Pond C), installation of transmission-line and water-pipeline corridors, renovation and partial rerouting of an existing railroad-spur corridor, and improvements to six offsite road areas. The section is divided into two subsections: terrestrial and wetland impacts and aquatic impacts.

4.3.1 Terrestrial and Wetland Impacts

This section provides information about the site-preparation and development activities of the proposed Lee Nuclear Station, Make-Up Pond C, two new transmission-line corridors, renovation and partial rerouting of the railroad-spur corridor, improvements to six offsite road areas, and related impacts on the terrestrial ecosystem. Topics discussed include habitat and associated wildlife impacts, important species and habitats, erosion and sedimentation control, building-related noise, and spill prevention and response.

4.3.1.1 Terrestrial Resources – Site and Vicinity

Site-Preparation and Plant-Building Activities

As described in the ER submitted by Duke (Duke 2009c) and a design update (Duke 2013d), site-preparation and plant-building activities in terrestrial habitats at the Lee Nuclear Station site include the following:

- installing erosion and sediment-control devices, and establishing related practices
- clearing vegetation by cutting or grubbing, and disposing of or recycling the resulting vegetative debris
- leveling the land by grading or filling
- creating spoil areas, laydown areas, and rail turnaround
- excavating to install building and other structural foundations
- excavating, installing, and backfilling new water intake and blowdown discharge pipelines and other station piping and utility connections
- disposing of dredged materials and spoils onsite

- pouring concrete foundations and erecting buildings
- leveling new parking lots and internal roadways by grading or filling
- creating stone (gravel) or paved roads and parking lots
- performing final grading and landscaping to permanently control erosion and runoff.

The majority of terrestrial ecology impacts result from site-preparation activities. Site-preparation activities for Units 1 and 2 are currently scheduled to begin in 2015 and to be completed in 2018 (Duke 2013a).

Upland Vegetation

Ecological cover types on the Lee Nuclear Station site are depicted in Figure 2-12 and described in Section 2.4.1.1. The structures and affected areas associated with proposed Units 1 and 2 are shown in Figure 3-4, and described in Sections 3.2 and 3.3. An analysis of the effects of the site-development footprint on vegetative cover suggests a total impact area of approximately 946 ac, including temporary habitat alteration (327 ac) and permanent habitat loss (619 ac). Table 4-1 summarizes the areas of cover types that would be affected by the temporary and permanent facilities associated with building Units 1 and 2 (Duke 2013d).

About 514 ac or 54 percent of the site-preparation and site-development footprint occurs in the open/field/meadow and upland scrub cover types (Table 4-1). This would affect about 86 percent of the collective open/field/meadow and upland scrub habitat that is available onsite. These cover types developed following cessation of building activities at the unfinished Cherokee Nuclear Station. The open/field/meadow and upland scrub cover types are considered to be of relatively low value to wildlife compared to the five forest cover types onsite (Duke 2012g), and are common in the region where abandoned agricultural and other previously disturbed sites are in the process of reverting back to forest.

Upland forests, including the mixed hardwood, mixed hardwood-pine, pine-mixed hardwood, open pine-mixed hardwood, and pine cover types that would be affected, are higher quality wildlife habitat due largely to relatively high plant species diversity and varied vertical structure (Duke 2008e). However, of these five forest habitat types, mixed hardwood and mixed hardwood-pine provide the greatest value to wildlife (Duke 2010c). Only about 423 ac, or 45 percent of the site-preparation and site-development footprint, occur in five forest cover types. This would affect about 40 percent of the total available area of these five habitat types onsite (Duke 2013d).

Merchantable timber may be harvested prior to site clearing. Non-marketable trees and other woody material would be grubbed and disposed of by burning, chipping, landfill disposal, or it may be recycled or reused elsewhere onsite for firewood, landscape mulch, wildlife habitat, and erosion or siltation control (Duke 2009c).

Table 4-1. Cover Types to be Cleared on the Lee Nuclear Station Site[a]

	Estimated Total Acreage	Estimated Area of Clearing by Cover Type (ac)[b]								
		MH	MHP	PMH	OPMH	P	NJF	OFM	USC	W
Building period[c]										
					8.11					
Laydown area	72.45	8.88	9.35	6.73				27.34	12.04	
Spoils area	254.31	63.50	41.36	51.47	39.75	7.34		12.48	38.41	
Subtotal	326.76	72.38	50.71	58.20	47.86	7.34	0	39.82	50.45	0
Permanent facilities[d]										
Power block	65.55						8.56	56.99		
Cooling towers	10.59							10.59		
Switchyard	19.80							19.80		
Meteorological tower	7.25		4.36	1.87					1.02	
Transmission	64.06	3.79	19.88	13.91				15.08	11.19	0.21[e]
Wastewater treatment	10.13		0.13	4.42			0.42	3.76	1.4	
PWS and WWS pipelines	23.47	3.23	3.67	1.82		0.12		10.83	3.80	
RWS pipeline	41.74	3.22	18.82	5.29	6.61			7.80		
General grading and transportation	376.58	38.02	25.67	16.40	12.68	2.42	0.27	245.97	35.15	
Subtotal	619.17	48.26	72.53	43.71	19.29	2.54	9.25	370.82	52.56	0.21
Total	**945.93**	**120.64**	**123.24**	**101.91**	**67.15**	**9.88**	**9.25**	**410.64**	**103.01**	**0.21**
Percentage of total	**100**	**12.75**	**13.03**	**10.77**	**7.10**	**1.04**	**0.98**	**43.41**	**10.89**	**0.02**

(a) Source for table and footnotes: Duke 2013d.
(b) Cover Type Key: mixed hardwood (MH), mixed hardwood-pine (MHP), pine-mixed hardwood (PMH), open pine-mixed hardwood (OPMH), pine (Pine), non-jurisdictional feature (NJF), open/field/meadow (OFM), upland scrub (USC), wetland (W).
(c) "Building period" activities correspond to temporary impacts. The "borrow area" category was eliminated, because the area for borrow material is no longer needed. "heavy-haul road and path," "parking," and "batch plant" categories will have permanent grading or other facilities located in the same area after completion of plant building and are therefore now included as permanent facilities under "general grading and transportation" to avoid double counting.
(d) "Permanent facilities" correspond to permanent impacts. The "transmission," "potable water service (PWS) and wastewater service (WWS) pipelines," and "raw water service (RWS) pipeline" categories were added. "warehouses," "parking," "vehicle maintenance," "simulator training," "clarifier area," "support and administration," "security training area," and "intake/discharge structures" categories are now included as permanent facilities under "General grading and transportation." Also, the disturbance associated with the railroad turnaround is included under "General grading and transportation."
(e) The onsite 230-kV transmission-line corridor crosses a total of 1.24 ac of wetlands; however, only 0.21 ac is forested. Only the 0.21-ac forested area will have vegetation altered (converted from forested to scrub-shrub wetland), whereas herbaceous wetlands will not be disturbed.

Construction Impacts at the Lee Nuclear Station Site

Site-preparation and clearing would be performed in accordance with Federal and State regulations and permit requirements and established BMPs (Duke 2008j). BMPs employ site preparation, surface stabilization, runoff control and conveyance, sediment traps and barriers, and stream protection measures that can be used effectively depending on site-specific conditions. Prior to initiating site development, Duke will prepare a SWPPP for Lee Nuclear Station using appropriate State or local specifications, such as those provided by the SCDHEC Storm Water Management Program (SCDHEC 2003). General measures to be considered for inclusion in the SWPPP as required by the NPDES permit for construction activities are identified below (Duke 2013d):

- Establish perimeter controls around the area to be disturbed and along the Limits of Disturbance boundaries by placing and maintaining appropriate sediment-control BMPs (e.g., silt fence, fiber rolls, vegetated buffer strips).
- Phase building activities (e.g., initial land-disturbance phase, construction phase, and stabilization phase) to minimize the duration of soil exposure. Exposed soil should be stabilized and covered with appropriate erosion-control BMPs (e.g., seeding, mulching, erosion-control blankets) within the time frame required by the SCDHEC.
- Use diversion ditches or berms to direct sediment-laden stormwater away from unprotected slopes and toward sediment-control devices (e.g., sediment basins, sediment traps, rock check dams).
- Schedule periodic and regular inspection and maintenance of all installed BMPs.

Additional practices to be included in the SWPPP are spill control and prevention measures for construction equipment, waste disposal requirements, dust-control measures, procedures for fertilizer/pesticide use, and non-stormwater discharge requirements. Following site-development activities, all areas cleared as temporary work areas (e.g., laydown areas, temporary parking lots, etc.) would first be re-vegetated in accordance with the Duke's BMPs for erosion control in compliance with the NPDES permit for construction activities issued by the SCDHEC. The site security staff would review long-term landscaping plans for the site to ensure an appropriately cleared security buffer. Duke's landscape architects would make landscape decisions for areas outside the security buffer. Past practices have been to mechanically disturb the soil to facilitate seed germination, amend soil where necessary, re-vegetate with native vascular plants, and allow natural succession to occur (Duke 2013d).

Approximately 411 ac of open/field/meadow, 103 ac of upland scrub, and 423 ac of the forest cover types onsite would be affected by building Lee Nuclear Station (Duke 2013d). Temporary work areas would be re-vegetated. Building activities would be conducted according to Federal and State regulations, permit conditions, existing procedures, and established BMPs. Therefore, building impacts on habitat on the Lee Nuclear Station site would be spatially extensive. However, Duke sited about half of the building impacts in previously disturbed open/field/meadow and upland scrub habitats. In addition, the forest cover types to be disturbed are largely fragmented.

Wetlands, Streams, and Floodplains

This subsection discusses the wetlands, streams, and floodplains on the Lee Nuclear Station site. Impacts on streams are discussed further in Section 4.3.2.1.

Jurisdictional Wetlands

Wetlands and waterways would be avoided by site-development activities to the greatest extent possible. For example, the river intake structure would be located just northeast of the 0.03-ac jurisdictional wetland that abuts the Broad River (USACE 2013a) (see Figure 2-13). This forested wetland falls outside of the footprint of the river intake structure; thus, no direct building impacts are anticipated. Installation of the river intake would be behind a cofferdam, preventing the release of sediment during installation activities, and there are no anticipated impediments to downstream flow in the Broad River except for behind the cofferdam (Duke 2008f). However, a slight increase in turbidity and settling of some sediment may occur when the cofferdam is installed (Duke 2009c). Soil and sediment cut from within the cofferdam would be deposited in an area designated for spoils disposal in the uplands of the Lee Nuclear Station (Duke 2008c). Thus, there would be no substantive sedimentation of the 0.03 ac forested wetland from installation of the river intake, and minimal effects on wetland vegetation are anticipated.

The river intake pipeline and access road would pass by but not through the 0.03-ac forested jurisdictional wetland (Duke 2008f, 2013h). Thus, no direct impacts on this wetland are anticipated from installation of the intake pipeline and access road. In addition, Duke's existing construction practices and BMPs (Duke 2008j) would be implemented, such as installing sediment filter devices (e.g., sediment tubes or silt fences) as necessary to prevent the flow of spoils from the pipeline corridor and restrict sediment flow into the wetland. Following pipeline emplacement, the pipeline corridor would be seeded with annual grasses or other species to stabilize the soil. The seeded species would not require fertilizer or other amendments. Following seeding, the disturbed area would be allowed to revegetate naturally with native herbaceous and small shrub species, largely approximating the open/field/meadow cover type that now occupies the site proposed for the pipeline. Thus, no sedimentation of the forested wetland is anticipated from building the river intake pipeline and access road. Large shrubs and trees would be precluded to establish a permanent corridor that would be maintained to facilitate visual survey of the pipeline ROW (Duke 2009c).

Hand-cutting of trees would be necessary within 0.21 ac of a 0.26-ac forested wetland located in uplands just west of the southwest corner of Make-Up Pond A (Figure 2-13) within the 230-kV onsite transmission-line corridor. These wetlands would be permanently converted to scrub-shrub wetlands. This vegetation conversion would be the only permanent impact on jurisdictional wetlands on the Lee Nuclear Station site (Duke 2011h).

The remaining jurisdictional wetlands that abut or are otherwise closely associated with Make-Up Ponds B and A (Duke 2012n) fall outside the site-development footprint and would not be permanently affected by building Units 1 and 2 (Duke 2009c); however, there may be temporary secondary impacts on certain jurisdictional wetlands that abut portions of Make-Up Ponds A and B. Temporary partial drawdown of the water level within Make-Up Ponds A and B would be required to relieve pressure on the cofferdams while building the associated intake/refill structures. Duke expects the water level would be drawn down 20 ft for approximately 32 months at Make-Up Pond A and for approximately 34 months at Make-Up Pond B (Duke 2012o).

Duke evaluated landscape position (wetland elevation relative to Make-Up Pond A or B, other wetlands, and streams), topographic location (depressions, floodplains, slopes), presence/absence of vegetation, vegetation type, soil type, and hydrology to identify the wetlands that may be affected (Duke 2013h). Because both Make-Up Ponds A and B are man-made impoundments in steep terrain, little littoral habitat is present, but some emergent vegetation is present in shallow coves and fringe wetlands (Duke 2012o). The temporary drawdown of Make-Up Pond A may affect a 3.85-ac freshwater marsh located in the southeast portion of the pond (Figure 2-13). Three wetlands comprising a total of approximately 1.61 ac and located in the uppermost reach (southwestern end) of Make-Up Pond B (Figure 2-13) may also be temporarily affected by the drawdown. Duke does not expect the drawdown to completely dewater the potentially affected wetland areas and expects them to continue to function as wetlands (Duke 2012o, 2013h).

In addition to implementing interim shoreline stabilization and erosion control in accordance with SCDHEC erosion-control procedures (Duke 2012o), Duke plans to install temporary dikes downstream of the potentially affected wetlands to maintain the hydrology of the existing wetlands (Duke 2012o). Duke intends to monitor the wetlands throughout the construction drawdown period and has proposed a pre-drawdown baseline qualitative floristic and hydrological survey, semi-annual (spring/fall) hydrology monitoring, and a floristic and hydrological survey one growing season after the ponds are refilled to the original full-pond elevation. Duke expects the shoreline/riparian vegetation affected during the drawdown would recover naturally via the existing seedbank. Nevertheless, if the results of the floristic survey after pond refill do not contain a prevalence of hydrophytic plant species identified in the baseline survey, Duke would provide supplemental seeding or planting (Duke 2012o). The South Carolina Department of Natural Resources (SCDNR) has concurred with the proposed work plan for drawdown of Make-Up Ponds A and B (SCDNR 2012m). All ecological monitoring and adaptive management would be performed in accordance with the terms and conditions of the Department of the Army permit and the SCDHEC 401 Water Quality Certification (Duke 2012o).

In addition, indirect impacts on jurisdictional wetlands just below the Make-Up Pond B dam and along the eastern shoreline of the southeastern arm of Make-Up Pond B (Figure 2-13) could result from dewatering the excavation of the unfinished Cherokee Nuclear Station during construction of Lee Nuclear Station. Groundwater may flow from the northeast side of Make-Up Pond B (Figure 2-10) toward the dewatered excavation (groundwater would not flow toward the excavation from anywhere else around the periphery of Make-Up Pond B) (see Section 2.3.1.2). The excavation has been dewatered almost continuously since 2005, and the water pumped to Make-Up Pond B (see Section 2.3.1.2). Thus, any possible dewatering of the four wetlands would not have been noticeable. However, during construction of proposed Lee Nuclear Station Units 1 and 2 (see Section 4.3.2.2), water from dewatering during excavation would instead be pumped to Hold-Up Pond A and could potentially draw down the wetlands. The vertical drawdown, if any, of the jurisdictional wetlands around the periphery of Make-Up Pond B, and the duration of drawdown, are uncertain. Nevertheless, drawdown, if any, and recharge would be consistent with seasonal precipitation patterns for Make-Up Pond B (i.e., drawdown likely during late spring, summer, and early fall months, and recharge likely during late fall, winter, and early spring months). Similar impacts on the jurisdictional wetlands around the periphery of Make-Up Pond A (Figure 2-13) are not anticipated because groundwater flow from Make-Up Pond A is not toward the dewatered excavation (Duke 2009c). Similar impacts on the wetlands located along the periphery of Make-Up Pond B outside its northeast corner, and/or upgradient of Make-Up Pond B (Figure 2-13), are also not anticipated.

Appropriate erosion and sediment-control measures, as described in the *Duke Energy BMPs for Stormwater Management and Erosion Control Policy and Procedures Manual* and the SCDHEC BMP Manual, would be employed for all activities occurring in proximity to jurisdictional waters of the United States to minimize potential indirect impacts on wetlands and streams (Duke Energy 1999; Duke 2008j, 2011h) and to comply with any conditions included in the Department of the Army permit issued by the USACE and the SCDHEC State 401 water-quality certification. The conditions for each authorization are site-specific, and usually require applicable BMPs, and typically include the following practices (Duke 2009c):

- Keep disturbance of vegetation and the substrate to a minimum.
- Grade and reseed disturbed areas (using native vegetation) to minimize erosion and preclude sedimentation.
- Avoid environmentally sensitive areas.
- Install waterway crossings only if no reasonable alternate exists, and minimize placing of fill material in the waterway or adjacent wetlands.

- Use temporary board roads or removable mats in wetlands and stream crossings.
- Totally remove any temporary fill material and restore the site to its original elevation.

In addition, to further protect adjacent waterbodies from indirect impacts during onsite construction activities, Duke intends to maintain a 50-ft undisturbed buffer zone around all existing protected areas, including wetlands, open waterbodies, and streams. Located between the surface waters and the outermost sediment and erosion-control BMPs, this 50-ft buffer zone is a 20-ft increase of the 30-ft buffer zone requirement by the NPDES permit for construction activities as set forth by the SCDHEC. The SWPPP would include a narrative addressing buffer zone maintenance and velocity dissipation measures for concentrated flows entering the buffer zone (Duke 2013d).

Installation of the river intake also would comply with the Department of the Army permit and the SCDHEC State 401 water quality certification. Use of erosion-control measures should also prevent the introduction of sediment into the nearby forested wetland. The river bank would be stabilized and re-vegetated after construction to minimize erosion by river currents (Duke 2011h). The Department of the Army permit would specify any needed mitigation or further restoration (Duke 2009c).

There would be no permanent or temporary impacts on jurisdictional wetlands along the Broad River on the Lee Nuclear Station site (Duke 2012n).

Non-Jurisdictional Features

The site-preparation and building footprint includes impacts on eight non-jurisdictional features encompassing 9.25 ac (Figure 2-13) (Duke 2013d) (Table 4-1). Five of these areas (8.56 ac, Figure 2-13) developed in depressions within the central portion of the unfinished Cherokee Nuclear Station and would be disturbed for installation of the Lee Nuclear Station power block. These non-jurisdictional features developed from rainwater that accumulated in the excavation for the unfinished Cherokee Nuclear Station and support primarily shrubby and herbaceous vegetation. They were dewatered prior to and during the removal of Cherokee Nuclear Station power-block structures in 2007 and seasonal rainwater continues to be removed from the depressions. These areas provide relatively little ecological function or value, and impacts on them would thus be considered negligible (Duke 2009c).

A 0.42-ac non-jurisdictional feature would be disturbed during building of the proposed Lee Nuclear Station wastewater-treatment facility and the two remaining non-jurisdictional features (0.11 and 0.16 ac, respectively) just west of Make-Up Pond A would be disturbed by general grading activities (Figure 2-13) (Duke 2013d). The soils in these areas are more typical of upland soil than hydric soil (see Section 2.4.1.1). Their ecological function and value are limited by this fact (Duke 2009c). Thus, impacts on them would be expected to be negligible.

Streams

Onsite 230-and 525-kV transmission-line structures would be located outside of jurisdictional streams in surrounding upland buffer areas. Hand-cutting of canopy trees would occur within stream buffers, but other buffer vegetation would remain intact. Duke has not quantified these impacts within stream buffers (see Aquatic Ecology Section 4.3.2) (Duke 2011h).

Floodplains

The power block as well as support buildings for Lee Nuclear Station would be sited outside the 100-year floodplain on the Lee Nuclear Station site (Duke 2011h). The intake structure would however cross the 100-year floodplain to reach the Broad River.

Wildlife

Impacts on wildlife would result from the permanent and temporary habitat losses described above. Wildlife may suffer mortality, disturbance, and displacement as a result of ground clearing and building activities. Less mobile animals, such as reptiles, amphibians, small burrowing mammals, and unfledged birds, would incur greater mortality than more mobile animals, such as adult birds and large mammals. Sublethal disturbance may adversely affect movements, feeding, sheltering, and reproductive behaviors. Mobile animals may be displaced into undisturbed habitat where increased competition for resources during building activities may result in increased predation and decreased fecundity, ultimately leading to temporary reductions in populations. Relatively large portions of the available upland cover types onsite would be affected by site preparation, as indicated in the above discussion, and similar habitats are available in adjacent areas onsite (e.g., south and west of Make-Up Pond B) and offsite. Thus, these undisturbed habitats would be available to animals displaced during ground clearing and building. In addition, site preparation would create early successional habitats from forest habitats that could be colonized by early successional species.

Species adapted to early successional habitat may be lost from the open/field/meadow and upland scrub habitats present on the proposed Lee Nuclear Station site. Such species may disperse into open/field/meadow and upland scrub habitats remaining onsite and in adjacent areas, and colonize early successional habitats created by site-preparation activities, such as re-vegetated laydown and spoil-disposal areas. Similarly, species adapted to forest/clearing interface environments may be lost from edge habitats that are destroyed by site preparation, but may disperse into edge habitats remaining onsite and present in adjacent areas, and colonize new edge habitats created by forest fragmentation. However, species dependent on interior forests could only disperse into forest habitats remaining onsite and present in adjacent areas. Thus, forest-interior wildlife may be affected to a greater extent than wildlife adapted to early successional or forest-edge habitats. However, because forest habitat remains onsite (e.g., south of Make-Up Pond B) and additional forest habitat is offsite, resource availability is not expected to be a factor limiting populations of affected forest-interior wildlife, although population levels and hence competition could increase in these adjoining habitats. Further, as forest succession takes place in temporary use areas (e.g., laydown and spoil-disposal areas) forest-interior wildlife would likely recolonize these areas; however, this would not occur for several decades.

Migratory bird collisions with tall construction equipment are possible. Studies of avian collisions with elevated construction equipment are lacking in the literature. The structures that are most similar to elevated construction equipment (e.g., cranes) and that pose the greatest threat of collision mortality are communication towers. The towers that appear to cause the most problems are tall, especially those that exceed 305 m (1000 ft), are illuminated at night with solid or pulsating incandescent red lights, are guyed, are located near wetlands and in major songbird migration pathways or corridors, and have a history of inclement weather during spring and fall migrations (Kerlinger 2004; Manville 2005). Published accounts of kills at short towers and other short structures are limited, and are usually associated with bad weather and lighting (Manville 2005). Although the Lee Nuclear Station site lies near a principal inland route of the Atlantic Flyway that extends through northern South Carolina (Bird and Nature 2009), substantial migratory bird collisions with construction equipment is unlikely because the anticipated equipment is of relatively low stature, is not guyed, is unlit, and would not be located near any major wetlands. Thus, migratory bird collision is not likely to be a substantial source of mortality.

Typical building activity noise is generated by internal combustion engines (e.g., front-end loaders, tractors, scrapers/graders, heavy trucks, cranes, concrete pumps, generators), impact equipment (e.g., pneumatic equipment, jackhammers, pile drivers, etc.), and other equipment such as vibrators and saws (Duke 2009c). Noise from building activities can affect wildlife by inducing physiological changes, nest or habitat abandonment, or behavioral modifications, or it may disrupt communications required for breeding or defense. However, it is not unusual for wildlife to habituate to such noise (AMEC Americas Limited 2005; Larkin 1996). Attenuated noise levels from various types of construction equipment would range from about 80 to 95 dBA (A-weighted decibels) at 50 ft from the source and would be reduced to a range of about 48 to 63 dBA at 2000 ft (Duke 2011b). It would be anticipated that some wildlife would avoid using areas within 400 ft of operating construction equipment (Bayne et al. 2008), where noise levels are expected to range from 62 to 76 dBA, below the 80- to 85-dBA threshold at which birds and small mammals are startled or frightened (Golden et al. 1980). Thus building activity noise is not likely to have noticeable effects on local wildlife.

Building-related increases in traffic would likely be most obvious on the rural roads of Cherokee County, specifically McKowns Mountain Road, a two-lane county road that will provide the only access to the proposed Lee Nuclear Station. Currently, it is estimated that approximately 950 vehicles a day travel on McKowns Mountain Road between SC 105 and the end of the road near the Broad River (Duke 2013a). During construction and preconstruction, up to

4510 vehicles would travel McKowns Mountain Road in each direction twice per day. Also, an estimated 100 truck deliveries will be made daily to the proposed site (see Section 4.4.4.1). This would likely increase traffic-related wildlife mortalities. Local wildlife populations could decline if roadkill rates were to be substantial. However, while roadkill is an obvious source of wildlife mortality and would likely increase during building activities, except for special situations not applicable to the Lee Nuclear Station (e.g., ponds and wetlands crossed by roads where large numbers of migrating amphibians and reptiles would be susceptible), traffic mortality rates rarely limit population size (Forman and Alexander 1998). Consequently, the overall impact on local wildlife populations from increased vehicular traffic on McKowns Mountain Road during construction and preconstruction would be expected to be negligible.

Vegetation clearing (including timber harvest) and grubbing would be scheduled, to the extent practicable, to avoid the migratory bird-nesting season (generally March through June). However, if avoidance is infeasible, Duke would amend its existing U.S. Fish and Wildlife Service (FWS) and SCDNR depredation permits (MB000257-0 and MD-19-10, respectively) (Duke 2010d).

Summary

The review team has determined that the site-preparation and development-related impacts of habitat loss and associated wildlife mortality, disturbance, and displacement would be spatially extensive, but allayed somewhat because a substantial portion of the impacts would occur in previously disturbed, low-quality habitat. In addition, collisions with elevated structures; noise; and increased traffic may adversely affect onsite wildlife. Construction and preconstruction of the proposed Lee Nuclear Station would be conducted according to Federal and State regulations, permit conditions, and established BMPs. Wetlands and waterways would be avoided to the extent possible. The review team concludes that construction and preconstruction impacts on habitat and associated wildlife on the proposed Lee Nuclear Station would be considerable, although not regionally destabilizing.

4.3.1.2 Terrestrial Resources – The Make-Up Pond C Site

Existing Cover Types

The ecological cover types in the Make-Up Pond C study area are shown in Figure 2-14. The infrastructure and affected areas associated with creating Make-Up Pond C are shown in Figure 3-5. The types of vegetation cover and acreages that would be permanently and temporarily affected within the Make-Up Pond C reservoir features, outside the inundation zone but within the Make-Up Pond C study area, and outside the Make-Up Pond C study area (transmission line-reroute) are provided in Table 4-2.

Table 4-2. Cover Types Affected During Construction of Make-Up Pond C[(a)]

	Estimated Disturbed Acreage	Cover Type[(b)]										
		OFM	P	PMH	USC	MH	MHP	OPMH				OW[(c)]
					Permanent Impacts							
Reservoir features												
Impoundment	618.83	88.13	104.45	9.91	1.06	308.77	101.11	-		-		5.4
Dam footprint	14.52	0.62	6.63	-	-	4.43	2.84	-	-	-	-	-
Saddle dikes	6.96	0.95	5.27	-	-	0.74	-	-	-	-	-	-
Make-Up Pond C spillway	2.38	-	0.01	-	-	1.74	0.63	-	-	-	-	-
Impacts outside inundation zone but within Make-Up Pond C study area												
Buck Mill Road	4.89	0.82	3.96	-	-	0.07	0.04	-	-	-	-	-
Grace Road	2.07	1.69	0.13	-	-	0.14	0.11	-	-	-	-	-
Heavy-haul roads and haul paths	0.9	-	-	-	-	-	-	-	-	-	-	0.9
Lake Cherokee spillway	0.43	0.43	-	-	-	-	-	-	-	-	-	-
Newly built road	3.40	-	0.16	-	2.14	-	1.10	-	-	-	-	-
Old Barn Road	8.03	8.03	-	-	-	-	-	-	-	-	-	-
Peeler Ridge Road	1.48	0.03	1.45	-	-	-	-	-	-	-	-	-
RWS pipeline	8.39	0.78	5.44	-	1.72	0.09	0.36	-	-	-	-	-
RWS pipeline break tank	0.16	-	-	-	0.16	-	-	-	-	-	-	-
Rip rap	0.29	0.23	-	-	-	0.06	-	-	-	-	-	-
Road to Make-Up Pond C	6.49	0.61	1.60	-	-	1.37	2.91	-	-	-	-	-
Rolling Mill Road	15.10	7.15	5.54	-	-	1.22	0.93	0.26	-	-	-	-
SC 329--new alignment	31.11	15.96	2.43	4.36	-	7.45	0.91	-		-		-
Transmission line--reroute	18.41	7.17	1.66	2.36	-	5.19	0.23	-	-	-	-	1.8
Railroad-line crossings	8.09	-	3.55	0.02	-	2.48	2.04	-	-	-	-	-
Spoils area	186.21	73.61	67.99	-	8.76	26.76	1.29	-		-		7.8
Vegetation clearing	102.47	10.77	31.05	4.71	-	34.39	21.55	-	-	-	-	-
White Road	6.33	5.64	0.64	-	-	0.05	-	-	-	-	-	-

Table 4-2. (contd)

	Estimated Disturbed Acreage	Cover Type[(a)]										
		OFM	**P**	**PMH**	**USC**	**MH**	**MHP**	**OPMH**				**OW**
Impacts outside Make-Up Pond C study area												
Transmission line--reroute	3.05	-	-	-	-	-	3.05	-	-	-	-	-
Total permanent impacts	**1049.99**	**222.62**	**241.96**	**21.36**	**13.84**	**394.95**	**139.10**	**0.26**				**15.9**
Temporary Impacts												
Impacts outside inundation zone but within Make-Up Pond C study area												
Borrow area	7.67	4.15	0.65	-	-	1.70	1.17	-	-	-	-	-
Dewatering pipe	0.03	-	-	-	-	0.03	-	-		-		-
Diversion pipe	0.36	-	-	-	-	0.34	0.02	-	-	-	-	-
Field office	0.11	0.11	-	-	-	-	-	-	-	-	-	-
Heavy-haul roads and haul paths	10.68	6.92	0.01	-	-	3.75	-	-	-	-	-	-
Laydown	4.78	3.21	-	-	1.04	-	0.53	-	-	-	-	-
Logging roads	12.80	0.25	3.36	6.98	1.19	1.02	-	-	-	-	-	-
Mechanics shop	0.17	0.17	-	-	-	-	-	-	-	-	-	-
Parking	13.03	9.37	1.95	-	-	0.61	1.10	-	-	-	-	-
Upstream cofferdam	0.18	-	-	-	-	0.12	0.06	-	-	-	-	-
Total temporary impacts	**49.81**	**24.18**	**5.97**	**6.98**	**2.23**	**7.57**	**2.88**	**-**				**-**
Total Impacts												
Permanent impacts	1049.99	222.62	241.96	21.36	13.84	394.95	139.10	0.26				15.9
Temporary impacts	49.81	24.18	5.97	6.98	2.23	7.57	2.88	-				-
Total impacts	**1099.80**	**246.80**	**247.93**	**28.34**	**16.07**	**402.52**	**141.98**	**0.26**	**-**	**-**	**-**	**15.9**

(a) Source for table and footnotes: Duke 2013d. The purpose of this table is to summarize impacts on terrestrial land cover types from construction at the Make-Up Pond C study area. Impacts on aquatic resources under the jurisdiction of the USACE (wetlands, streams, and open waters) are provided in Sections 4.3 and 9.5 and Table 9-19).

(b) Cover Type Key: Open/Field/Meadow (OFM), Pine (P), (Pine-Mixed Hardwood (PMH), Upland Scrub (USC), Mixed Hardwood (MH), Mixed Hardwood-Pine (MHP), Open Pine-Mixed Hardwood (OPMH), Open Water (OW).

(c) Open-water (OW) cover type acreages (15.9 ac) were derived using aerial photo interpretation. Open waters were subsequently surveyed in the field during the Jurisdictional Determination resulting in a more accurate acreage estimate (17.58 ac) for impacts on open waters (part of the combined total open water impacts of 29.63 ac noted for the Lee Nuclear Station site and Make-Up Pond C in Tables 9-19 and 9-20).

All impact areas within the reservoir footprint (Table 4-2) are considered permanent because of inundation (Duke 2010c). Facilities where the possibility of both temporary and permanent impacts exists (e.g., temporary workspace necessary for the spillway installation) are conservatively considered to be permanent in Table 4-2.

Some noteworthy linear building features span the Make-Up Pond C study area outside the inundation zone. For example, an approximately 2-mi-long portion of an existing out-of-service 44-kV transmission line with a 100-ft-wide ROW would need to be removed and a new transmission ROW rerouted (Figure 3-5). A new transmission line is not currently needed and would not be installed in the new ROW until a need is identified (Duke 2011h).

The plan to use an overhead transmission line to power the Make-Up Pond C intake/refill structure has been eliminated. Instead, the Make-Up Pond C intake/refill structure would be powered with underground cables from the Lee Nuclear Station that would be routed below ground within the area of disturbance for the raw water service (RWS) pipeline (see Figure 3-5). The RWS pipeline that would connect Make-Up Pond C to the existing Make-Up Pond B (Figure 3-4 and Figure 3-5), would have a 200-ft-wide corridor, and would require vegetation clearing both within the Make-Up Pond C study area (Table 4-2) and within the Lee Nuclear Station site (Table 4-2) (Duke 2013d). Finally, SC 329 would need to be realigned and would require vegetation clearing outside the inundation zone but within the Make-Up Pond C study area (Figure 3-5 and Table 4-2).

The heavy-haul road and paths appear twice in Table 4-2, once under permanent and once under temporary impacts outside the inundation zone but within the Make-Up Pond C study area. The heavy-haul road and paths outside the inundation zone would be restored after building Make-Up Pond C (temporary impact), except where they cross areas of farm ponds, which would not be restored to open water (permanent impact) (Duke 2010c).

A total of approximately 1100 ac of various habitat types would incur permanent (approximately 1050 ac) and temporary loss and alteration (approximately 50 ac), resulting from impacts such as flooding and clearing (Table 4-2). The mixed hardwood and mixed hardwood-pine cover types are of higher value to wildlife than the other cover types depicted in Figure 2-14. Cumulatively, these two cover types account for 47.4 percent (approximately 1000 ac) of the total cover (approximately 2110 ac) in the Make-Up Pond C study area (Table 2-8) (Duke 2013d). Approximately 545 ac of these two cover types within the Make-Up Pond C study area would be permanently (approximately 534 ac) or temporarily disturbed (approximately 11 ac) during reservoir development (Table 4-2).

Other cover types of lesser habitat quality include pine, open/field/meadow, pine-mixed hardwood, upland scrub, and open pine/mixed hardwood. Habitat quality in these five cover types is relatively low due to intensive management from past silvicultural and agricultural activities (Duke 2010c). These five cover types account for 51.6 percent (approximately

1090 ac) of the total cover in the Make-Up Pond C study area (approximately 2110 ac) (Table 2-8) (Duke 2013d). Approximately 539 ac of these five cover types within the Make-Up Pond C study area would be permanently (approximately 500 ac) and temporarily disturbed (approximately 39 ac) during reservoir development (Table 4-2).

Aerial photographs (USGS 2004) and satellite imagery (USDA 2009b) indicate that the cover types (but not subtypes) identified above for the Make-Up Pond C study area also are common in adjacent watersheds (Duke 2010n). However, while these cover types are common outside the Make-Up Pond C study area, examination of aerial photos from the 2009 National Agriculture Imagery Program overlaid on the U.S. Geological Survey (USGS) National Hydrography Data set (at an approximate scale of 1:10,000 and in natural color) indicates that lowland hardwood forest along London Creek (3.76 mi long) is wider and more continuous than the lowland hardwood forest of nearby streams of similar length (3.1 to 4.3 mi) (i.e., Doolittle Creek, Cherokee Creek, Bells Branch, Nells Branch, Kings Creek, and Abingdon Creek). Lowland hardwood forest along these other streams appears to be narrower and more fragmented, mostly by agriculture (i.e., pasture, hay fields) and silviculture (i.e., clearcut areas, shrub/scrub early successional areas, planted pine forests). To provide an objective assessment of the vegetation cover types in the riparian zone of the stream courses, each stream in the USGS 2006 National Landcover Data Map was buffered at 100 m (328 ft) (believed to encompass most or all of the associated stream valley) and the percentages of vegetation cover types (as defined in the USGS National Landcover Data map) within the buffer area were summarized for each creek (Table 4-3). This analysis shows that, compared to the other six stream courses, the London Creek riparian zone has the highest amount of deciduous forest and woody wetlands (approximately 79.2 percent of the buffered area) and the lowest amount of development and agriculture (6.6 percent). This relatively high amount of forest versus maintained land is consistent with the SCDNR's description of the London Creek watershed as having relatively high habitat integrity (SCDNR 2011b).

The mixed hardwood and mixed hardwood-pine cover types are virtually contiguous in the lowlands of London Creek, Little London Creek, and their tributaries in the Make-Up Pond C study area (Figure 2-14). Virtually all of this high-quality habitat would be permanently lost by building and inundating Make-Up Pond C. The affected forest habitat consists primarily of the bluff hardwood forest and lowland hardwood forest subtypes (of mixed hardwood forest). The bluff hardwood and lowland hardwood forest subtypes are the most undisturbed of the mixed hardwood forest habitat subtypes in the Make-Up Pond C study area (see descriptions in Section 2.4.1.2).

Table 4-3. Vegetation Cover Type Percentages Within 100 m (328 ft) of London Creek and Six Similar Nearby Creeks

Creek Name	Developed	Deciduous Forest	Evergreen Forest	Mixed Forest	Scrub/Shrub	Herbaceous	Agriculture	Woody Wetlands	Total
Abingdon Creek	1.3	53.3	30.2	2.4	3.6	2.7	6.2	1.6	**100.0**
Bells Branch	2.4	72.4	4.4	6.0	1.3	5.3	8.1	0.0	**100.0**
Cherokee Creek	7.3	61.4	2.3	1.0	0.9	2.8	21.7	0.7	**100.0**
Doolittle Creek	6.4	55.0	13.7	3.6	2.2	3.5	13.8	1.2	**100.0**
Kings Creek	1.9	67.5	10.6	8.1	0.6	2.5	5.7	3.1	**100.0**
London Creek	1.9	78.9	5.9	1.8	4.1	1.9	4.7	0.3	**100.0**
Nells Branch	2.3	75.4	4.9	3.1	1.9	5.1	7.4	0.0	**100.0**

Source: data created in 2012 by Pacific Northwest National Laboratory from USGS 2006 National Land Cover Data Map (USGS 2012).

Drastic declines of critical lowland hardwood habitats have occurred statewide over the years, but particularly in the upstate (SCDNR 2011b), and development of Make-Up Pond C would destroy more of this valuable habitat type (see Section 2.4.1.2) and the transitional areas adjacent to it. In addition, based on the above analysis, the London Creek forested riparian corridor is relatively wide, compared to other nearby streams. In the Piedmont ecoregion of South Carolina, plantation pine or pasture is often within only a few feet of the stream (SCDNR 2011b). For neotropical migrant songbirds, many of which are of conservation priority (see Section 2.4.1.2), the intact lowland hardwood forest they need may already be limited in South Carolina (SCDNR 2011b). Kilgo et al. (1998) have positively associated the species richness of neotropical migrant birds with the width of bottomland hardwood forest (considered part of the London Creek lowland hardwood forest complex described in Section 2.4.1.2) in South Carolina. Conservation of wide riparian zones is necessary to maintain the complete avian community characteristic of bottomland hardwood forests in South Carolina (Kilgo et al. 1998). These habitats may permit the maintenance of regional avian diversity in the highly fragmented landscape of the Piedmont. Further, the high amphibian and reptile diversity of the London Creek system is due to habitat diversity (e.g., microhabitat types including stream channel, small tributaries, seepage wetlands, isolated wetlands, floodplain, bluffs, etc.) and integrity. Because of their susceptibility to habitat and water-quality degradation, the amphibian assemblage, in particular the high salamander diversity (see Section 2.4.1.2), is an excellent indicator of the relatively high environmental integrity of the London Creek site (SCDNR 2011b). The abundance of lowland hardwood forest habitat of this quality elsewhere in the upstate Piedmont is unclear.

Following inundation of Make-Up Pond C, the remaining mixed hardwood forest would consist primarily of the upper and mid-slope mixed hardwood forest and cutover mixed hardwood forest subtypes, which are the most disturbed of the mixed hardwood forest subtypes in the Make-Up Pond C study area. The upper and mid-slope mixed hardwood forest and cutover mixed hardwood forest subtypes, together with the remaining mixed hardwood-pine cover type, would be highly fragmented and interspersed with the pine, open/field/meadow, pine-mixed hardwood, upland scrub, and open pine/mixed hardwood cover types in the uplands around the periphery of Make-Up Pond C (Figure 2-14).

All land clearing would be conducted according to Federal and State regulations, permit requirements, Duke's existing construction practices, and established BMPs (Duke 2008j). BMPs seek primarily to keep soil in place (erosion control) and secondarily to capture any sediment that is moved by stormwater before it leaves the site (sediment control). Areas cleared of vegetation and access roads would be watered to attenuate fugitive dust. Equipment and maintenance would be located away from wetlands and open water. Environmentally sensitive areas would be avoided where feasible (Duke 2010c). As previously discussed in Section 4.3.1.1, Duke would prepare a SWPPP for the Lee Nuclear Station using appropriate State or local specifications, such as those provided by the SCDHEC Storm Water Management Program (SCDHEC 2003). General measures to be considered for inclusion in the SWPPP, as required by the NPDES permit for construction activities, are also identified in Section 4.3.1.1.

Temporary roads and buildings would be removed upon completion of Make-Up Pond C. All areas cleared as temporary building areas would be re-vegetated in accordance with Duke BMPs for erosion control in compliance with South Carolina stormwater permits. The site security staff would review long-term landscaping plans for the site to ensure an appropriately cleared security buffer. Duke's landscape architects would make landscape decisions for areas outside the security buffer. Practices for restoration of terrestrial habitat performed by Duke include mechanical disturbance of the upper several inches of soil to facilitate seed germination, application of soil amendments where necessary, revegetation using native vascular plants, and allowing natural succession to take place (Duke 2013d).

<u>Wetlands, Streams, and Floodplains</u>

This subsection discusses the wetlands, streams, and floodplains on the Lee Nuclear Station site. Impacts on streams are discussed further in Section 4.3.2.1. Permanent, clearing, and temporary impacts would occur in wetlands, and clearing impacts would occur along streams. Most impacts would be associated with building the Make-Up Pond C impoundment. Other permanent impacts would include placement of excess spoil material, excavation for onsite fill material, construction of temporary haul roads, and the realignment of SC 329. Locations of these activities within the Make-Up Pond C footprint would also ultimately be inundated when the pond is filled (Duke 2011h).

Jurisdictional Wetlands

All wetlands within the proposed inundation area for Make-Up Pond C would be mechanically cleared of vegetation prior to inundation (Section 9.5.3). The largest permanent impact on wetlands within the Make-Up Pond C study area would result from inundation (3.22 ac). The inundation area would include areas previously altered by the construction of haul roads and subsequently flooded. As much as about 0.3 ac of permanent wetland impacts outside the Make-Up Pond C inundation footprint would result, including filling from construction of the Make-Up Pond C dam (0.04 ac), filling with spoil material from grading activities (0.24 ac), and filling resulting from the realignment of SC 329 (0.01 ac). Other permanent wetland impacts that would occur outside the Make-Up Pond C inundation footprint would result from mechanized clearing of vegetation within the 50-ft buffer (i.e., a 50-ft wide area around the full-pond elevation of Make-Up Pond C) and conversion of this area (less than 0.01 ac) to emergent wetland. Temporary wetland impacts outside the Make-Up Pond C inundation footprint would result from temporarily filling 0.04 ac of wetland within the 50-ft buffer. Temporary riparian impacts outside the Make-Up Pond C inundation footprint would also result from cutting 884 ft of stream shoreline vegetation within the 50-ft buffer area (Duke 2012n).

Additional indirect impacts on wetlands may occur because of stream diversion (e.g., around construction sites at the Make-Up Pond C dam, the London Creek railroad culvert, the new SC 329 bridge, and the installation of cofferdams). Stream diversion may drain wetlands downstream; and wetlands may remain drained for extended periods. For example, London Creek flow would be diverted (i.e., blocked by cofferdams and pumped) around the dam footprint during construction of Make-Up Pond C. However, because few wetlands downstream of the proposed dam derive their hydrology from overbank flooding from London Creek, stream diversion, dewatering pumps, and flow interruption may have only minor effects on wetlands downstream of Make-Up Pond C.

Transmission-line structures would be located outside of stream buffers, and BMPs for installation of transmission lines in riparian areas (Duke 2008j) would be implemented. BMPs for transmission-line corridor and structure installation consist of considerations for site preparation, sediment traps and barriers, access road placement, stream crossings, runoff-control measures, structure placement, and surface-stabilization measures. Thus, because a majority of the riparian buffers would remain intact (Duke 2010n), little impact is expected on the several unnamed tributaries that would be crossed by rerouting the existing 44-kV transmission line. Duke BMPs (Duke 2008j) would be implemented when building activities occur proximate to wetlands or streams. Typical BMP requirements are listed in Section 4.3.1.1 for jurisdictional wetlands on the Lee Nuclear Station site. In addition, as previously discussed in Section 4.3.1.1, to further protect adjacent waterbodies from indirect impacts during onsite construction activities, Duke intends to implement a 50-ft undisturbed buffer zone around existing protected areas, such as wetlands, open waterbodies, and streams (Duke 2013d).

A mitigation action plan, including compensatory mitigation incorporating restoration and preservation, for permanently or temporarily affected waters of the United States (e.g., wetlands and streams) within the jurisdiction of the USACE would be developed and implemented by Duke according to conditions to be set forth in an individual Department of the Army permit issued by the USACE and the associated CWA Section 401 water-quality certification issued by the SCDHEC (Duke 2010n). Duke has discussed an approach to compensatory mitigation with the USACE, which is described in Section 4.3.1.7. Site-specific BMPs also would be stipulated by the Department of the Army permit.

Make-Up Pond C, when developed, would provide approximately 620 ac of open-water habitat and could potentially develop some littoral wetlands in areas of shallow bathymetry around its margins and in tributary areas (Duke 2010n, 2011h, 2012j). However, according to USACE operating procedures (USACE 2010a), the subsequent provision of open-water habitat and the possible eventual provision of some littoral wetlands following inundation of a stream system does not offset or reduce impacts on the existing (open-water or wetland) resources and would not count toward meeting wetland mitigation requirements.

The main dam of Make-Up Pond C would be sited in a 100-year floodplain (Duke 2011h). Most of the narrow floodplain associated with London Creek would be permanently inundated. Any potential floodplain impacts would be avoided as indicated below for offsite road improvements in Section 4.3.1.5.

Significant Natural Areas, Noteworthy Ecological Associations, and Rare Plants

Duke identified 10 significant natural areas within the Make-Up Pond C study area (see Section 2.4.1.2) (Gaddy 2009). They contain rare plant communities, rare plant species, or mature to old-growth trees, and range in size from around 0.5 ac to just over 5 ac. Seven areas lie within the inundation zone: the Cinnamon Fern Bog, Laurel Ravine, West Bluff, West Bottoms, Sampling Location 1.7 and Adjacent Bluff, Fern Ravine, and Chain Fern Bog. Two areas lie outside the inundation zone in the Make-Up Pond C study area downstream of the proposed dam and saddle dike on London Creek: Rhododendron Bluff and London Creek Bottoms. London Creek Bottoms may be temporarily and minimally affected (0.03 ac) by clearing mixed hardwood, mixed hardwood-pine, and pine forest types (Figure 2-14) for replacement of the existing railroad-spur culvert with an expanded culvert where London Creek crosses the spur (Figure 3-5) (Duke 2009b, 2012j). Rhododendron Bluff is located far enough below the impact area of the proposed dam upstream and above the impact area of railroad-spur culvert replacement downstream that no impacts on this significant natural area are anticipated. The tenth significant natural area, Little London Creek Bottoms, lies outside the inundation zone in the Make-Up Pond C study area. The lowland hardwood forest along Little London Creek (Figure 2-14) would not be directly affected by building activities; however, a spoil area would be established adjacent to it (Figure 3-5). Consequently, 7 of these 10 significant natural areas would be permanently lost, and an eighth significant natural area likely would be disturbed. The abundance of such significant natural areas, either individually or collectively, in watersheds of similar size elsewhere in the upstate Piedmont is unclear.

Four noteworthy ecological associations with State ranks that range in susceptibility from vulnerable (S3) to imperiled (S2)—Piedmont acidic mesic mixed hardwood forest, Piedmont beech/heath bluff, Piedmont basic mesic mixed hardwood forest, and Piedmont streamside seepage swamp—also are of concern to the State of South Carolina (SCDNR 2011b) and also would be affected by the creation of Make-Up Pond C. None of these ecological associations were previously documented in Cherokee County, and only mesic mixed hardwood forest is known to occur in York and Union Counties (SCDNR 2012a), indicating their possible scarcity in that part of the Piedmont.

Occurrences of five plant species (i.e., mountain holly [*Ilex montana*], golden ragwort [*Senecio aureus*], tuberous dwarf-dandelion [*Krigia dandelion*], yellowish milkweed vine [*Matelea flavidula*], and Kral's sedge [*Carex kraliana*]) considered uncommon would also be affected by the creation of Make-Up Pond C (Gaddy 2009). These plant species are not designated as Federally threatened or endangered or as State-ranked species. Such species are discussed in Section 4.3.1.6. Tuberous dwarf-dandelion was also observed in Kings Mountain National Military Park, located about 10 mi northeast of the Make-Up Pond C study area (White and Govus 2005). The prevalence of the tuberous dwarf-dandelion and the other species listed above, either individually or collectively, in watersheds of similar size elsewhere in the upstate Piedmont is unclear. However, loss of occurrences of these species in the Make-Up Pond C study area would have only minor adverse effects on the species range-wide because they are considered apparently secure globally (global conservation status rank G4 [yellowish milkweed vine]) or secure globally (global conservation status rank G5 [other four species]) (NatureServe Explorer 2013).

The significant natural areas, noteworthy ecological associations of concern to the State of South Carolina, and uncommon plant species attest to the integrity and diversity of the London Creek lowland hardwood forest. The number of these resources, either individually or collectively, in watersheds of similar size elsewhere in the upstate Piedmont is unclear.

Lake Cherokee

The creation of Make-Up Pond C would inundate approximately 2.4 ac of mixed hardwood forest within the Lake Cherokee property owned by the SCDNR. Another 1 ac of mixed hardwood forest within the Lake Cherokee property would be cleared within the 50-ft buffer for the pond, but would be allowed to revegetate naturally upon completion of building activities. Approximately 1 ac of open/field/meadow cover type at the Lake Cherokee Dam would be affected by the inundation of Make-Up Pond C and associated improvements to the downstream toe of Lake Cherokee Dam and the Lake Cherokee emergency spillway (Duke 2010h; 2012j, n). The impact acreages of these communities within the Lake Cherokee property are included in Table 4-2. No other effects on terrestrial communities within the Lake Cherokee property are anticipated (Duke 2010h).

Wildlife

Wildlife present in the reservoir footprint, outside the inundation zone but within the Make-Up Pond C study area, and outside the Make-Up Pond C study area (transmission-line reroute) would suffer mortality, disturbance, and displacement as a result of inundation and the other building activities identified in Table 4-2. In general, animals that are less mobile, such as amphibians, reptiles, small burrowing mammals, and unfledged birds, would incur greater mortality than animals that are more mobile, such as adult birds and large mammals.

Vegetation clearing (including timber harvest) and grubbing would be scheduled for the summer, fall, and winter periods. Thus, if vegetation clearing began at the end of June, after most migratory bird young have fledged, only minor impacts on unfledged birds would be expected. However, if vegetation clearing began at the beginning of June, more substantive impacts on unfledged migratory birds would be expected. If avoidance is not feasible, Duke would amend its existing FWS and SCDNR depredation permits (MB000257-0 and MD-19-10, respectively) (Duke 2010d). Regardless of the timing of vegetation clearing, inundation would likely result in declines in avian numbers and possibly species diversity in the watershed (Ransom and Slack 2004).

Disturbances below lethal levels may adversely affect wildlife behaviors, such as movement, feeding, sheltering, and reproduction. Mobile animals may be displaced into nearby undisturbed habitat where increased competition for resources during building activities may result in increased predation and decreased fecundity, ultimately leading to temporary population reductions.

Riparian and wetland species would be lost from the relatively undisturbed lowland mixed hardwood and mixed hardwood-pine habitat along London Creek and many of its tributaries. Except for the adjacent Little London Creek riparian zone, there would be little nearby habitat of similar type and quality (Figure 2-14) to accommodate riparian and wetland species displaced from the London Creek system. Forest-interior-dwelling species, those requiring habitat conditions in the interior of large forests (e.g., lowland hardwood forest along London Creek) to breed successfully and maintain viable populations (e.g., scarlet tanager [*Piranga olivacea*], hooded warbler [*Wilsonia citrina*]) (DTA 2008b; MDDNR 2011), would be similarly affected, because mostly fragmented disturbed forest would remain in the London Creek watershed around the periphery of Make-Up Pond C following inundation. Species adapted to early successional habitat would be lost from the open/field/meadow and upland scrub habitats but could disperse into similar habitats in adjacent areas (Figure 2-14) that would not be used as spoil or parking areas (Figure 3-5). Similarly, species adapted to forest/clearing interface environments may be lost from and disperse into edge habitats that are destroyed and subsequently re-created by inundation or forest clearing, respectively. Thus, creation of Make-Up Pond C would pose temporary adverse effects for some species that inhabit early successional habitat or use edge environments. However, it is expected that long-term mortality, disturbance, and displacement would be incurred to a much greater extent for riparian, wetland, or forest-interior-dwelling species than for species dwelling in open habitats or forest edges.

Noise levels associated with creating Make-Up Pond C and its associated infrastructure are anticipated to be comparable to or less than noise levels associated with building activities at the Lee Nuclear Station site. Thus, the impact on wildlife from site-development noise is expected to be temporary and minor. The potential for traffic-related wildlife mortality is expected to be low because construction crews would be small (103 persons; see Section 4.4.2) and dispersed over very large geographic areas. Avian mortality resulting from collisions with structures and equipment during Make-Up Pond C creation would represent a small hazard for bird populations, particularly when compared to impacts resulting from habitat loss.

Several farms ponds within the Make-Up Pond C study area (Figure 2-15) would be drained and filled with spoil material when the 44-kV transmission line is rerouted (Figure 3-5, Table 4-2) (Duke 2009b, 2010c, n). Duke will discuss the disposition of turtles present in the ponds with the SCDNR before dewatering takes place (Duke 2010d).

The farm ponds are situated within a large field, with no buffering shrubs or trees or other nearby cover. Although no waterfowl have been observed at these ponds, they may provide feeding or loafing habitat for Canada geese (*Branta canadensis*), which may graze on the surrounding grass and available aquatic plants. Canada geese are the only waterfowl species that has been observed within the Make-Up Pond C study area (DTA 2008b). The lack of cover and level of disturbance at these ponds likely preclude the presence of other waterfowl. Other open waterbodies in the vicinity, including Ninety-Nine Islands Reservoir, Lake Cherokee, and Make-Up Ponds A and B, provide habitat if any geese or other waterfowl are displaced by rerouting of the transmission line (Duke 2010h).

A 300-ft buffer would be designated largely in relatively disturbed, degraded forested habitats and open/field/meadow habitat (Figure 2-14). The largely disturbed/degraded nature of the forest and open habitat in the surrounding 300-ft buffer would at least temporarily reduce the functionality of the Make-Up Pond C periphery as a wildlife travel corridor compared with the relatively undisturbed existing forest cover along London Creek and its tributaries. However, vegetation within the 300-ft buffer would be left in its natural state (Duke 2009b) and would be expected to somewhat improve the functionality of the Make-Up Pond C periphery as a wildlife travel corridor over the long term as succession toward hardwood forest occurs. In summary, a lesser degree and quality of connectivity would remain among the Lake Cherokee area, London Creek, and the Broad River floodplain. This may particularly be the case for birds that use forested riparian corridors during migration.

Summary

Make-Up Pond C would be the largest reservoir to be permitted in the State of South Carolina since the creation of Lake Russell in 1984 (SCDNR 2010b and USACE 2011b). The creation of Make-Up Pond C would permanently alter the nature of the terrestrial habitat and wildlife resources in the London Creek watershed. Most notably, Make-Up Pond C would destroy about 534 ac of relatively undisturbed mixed hardwood and mixed hardwood-pine forest along most of the length of London Creek and its tributaries. Make-Up Pond C would inundate seven significant natural areas and the related railroad-spur culvert replacement would minimally disturb one additional significant natural area. Four noteworthy ecological associations of concern to the State of South Carolina, occurrences of five uncommon plant species, 3.55 ac of jurisdictional wetlands, and vegetation along 884 linear ft of jurisdictional stream would also be affected by the creation of Make-Up Pond C. The creation of Make-Up Pond C would destroy diverse amphibian and reptile assemblages that are indicative of the variety and integrity of terrestrial habitats in and adjacent to the lowland hardwood forest along London Creek and its tributaries. Creation of Make-Up Pond C also would alter the functionality of the London Creek corridor as a wildlife travel corridor, particularly for neotropical migrant songbirds, many of which are of conservation priority. The abundance of watersheds of similar size in the upstate Piedmont that support similar high-value resources, either individually or collectively, is uncertain.

Make-Up Pond C would be created in accordance with Federal and State regulations, permit conditions, and established BMPs. Unavoidable impacts on jurisdictional wetlands and streams would be mitigated (see Section 4.3.1.7). Nevertheless, the review team has determined that the related impacts of habitat loss and wildlife mortality, disturbance, and displacement would be substantial and mostly permanent in nature, largely due to the effects of inundation. In addition, some important attributes of these resources would be permanently lost. The SCDNR has indicated that the London Creek watershed and the habitat and wildlife resources found there represent intact examples of other watersheds with similar resources in the upstate Piedmont (SCDNR 2011b). Therefore, the review team concludes that site-preparation and development-related impacts on habitat and associated wildlife from the creation of Make-Up Pond C would be noticeable but not destabilizing to such resources across the Piedmont ecoregion.

4.3.1.3 Terrestrial Resources – Transmission-Line Corridors

The power generated by the proposed Lee Nuclear Station would be transmitted via overhead transmission lines to a 230-kV switchyard and a 525-kV switchyard located on the Lee Nuclear Station site (Figure 3-4). Two double-circuit 230-kV and two single-circuit 525-kV lines would exit the switchyards. The four transmission lines would require development of two transmission-line corridors—Route K (western corridor) and Route O (eastern corridor). The routing and distances of these corridors and their 230-kV and 525-kV lines are shown in Figure 2-5 and described in Sections 2.2.3.1 and 3.2.2.3.

Existing Cover Types

The area within the two proposed transmission-line corridors is approximately 987 ac (see Table 2-3) in Cherokee and Union Counties. Vegetative cover types and acreages are noted in Table 2-3 (Duke 2007c). The greatest impact on land cover would result from clearing the corridors for the transmission lines and the resulting effects on wildlife habitat (Duke 2007c). Clearing would affect approximately 690 ac of various forest and woodland cover types (see Table 2-3) (Duke 2007c). About 87 ac of dry scrub/shrub thicket and 0.4 ac of wet scrub/shrub thicket also would be lost (see Table 2-3) (Duke 2007c). The upland scrub cover type is considered to be of relatively low value to wildlife compared to the forest cover types (Duke 2009c) and is common in the region.

Wetlands, Streams, and Floodplains

<u>Jurisdictional Wetlands</u>

Transmission-line structures would be located outside of jurisdictional waters of the United States (wetlands and streams) in surrounding upland buffer areas. A total of 1.15 ac of forested wetlands would be hand-cleared within the new transmission-line corridors. Hand-clearing of canopy trees would occur on 0.66 ac of the 10.64 ac of jurisdictional wetlands within the western corridor (Route K) and on 0.49 ac of the 0.52 ac of jurisdictional wetlands in the eastern corridor (Route O) (see Section 2.4.1.3) (Duke 2011h). Clearing would be limited to that required for conductor clearance, and understory buffer vegetation would remain intact. A naturally vegetated buffer zone that is at least 25 ft wide would be maintained adjacent to wetlands and streams.

In other upland areas within the corridors, all vegetation would be cleared by mechanized equipment. Topsoil would not be graded and root systems would be left intact to the greatest extent possible for regeneration. The width of clearing would be 200 ft when the corridor contains only a 525-kV line, and 325 ft when the corridor contains 525 and 230-kV lines. Vegetation would be removed and disposed of according to local, State, and Federal regulations (Duke 2011h).

The location and extent of roads to access the corridor and facilitate construction of the transmission-line structures have not been identified at this time. All construction roads would be located and designed to minimize ground disturbance, avoid excessive cutting and filling, and avoid impacts on jurisdictional wetlands and streams. Temporary roads would be seeded with permanent vegetation upon completion of construction activities (Duke 2011h).

Appropriate erosion and sediment-control measures, as described in the *Duke Energy BMPs for Stormwater Management and Erosion Control Policy and Procedures Manual* and the SCDHEC BMP Manual would be employed for all transmission-line construction activities occurring in proximity to jurisdictional waters of the United States in order to minimize potential indirect impacts on wetlands and streams (Duke 2011h, 2012m). BMPs for transmission-line-corridor and structure installation consist of considerations for site preparation, sediment traps and barriers, access road placement, stream crossings, runoff-control measures, structure placement, and surface-stabilization measures.

Because Duke's BMPs would be implemented, transmission-line structures would be located in uplands, and the extent of forested wetlands affected would be limited, only minor wetland impacts (e.g., permanent conversion from forested wetlands to scrub-shrub and emergent wetlands) are expected within the transmission-line corridors. There would be no other permanent or temporary impacts in the transmission-line corridors (Duke 2011h).

A mitigation action plan, including compensatory mitigation and/or restoration, for permanently or temporarily affected waters of the United States (e.g., wetlands and streams) under the jurisdiction of the USACE would be developed and implemented according to conditions set forth in the Department of the Army permit and the associated SCDHEC 401 water-quality certification (Duke 2010c, n). Duke has discussed a preliminary approach to compensatory mitigation with the USACE, as described in Section 4.3.1.7.

Transmission lines would be sited outside 100-year floodplains to the greatest extent possible (Duke 2011h), and any potential floodplain impacts would be avoided as indicated below for offsite road improvements in Section 4.3.1.5.

Significant Natural Areas and Rare Plants

A mixed hardwood bluff that is reportedly species-rich (Gaddy 2010) was found on Abingdon Creek along the eastern transmission-line corridor (Route O) (see Section 2.4.1.3). Nerveless sedge (*Carex leptonervia*), an uncommon mesic-site species not reported to occur in South Carolina by the *South Carolina Plant Atlas* (University of South Carolina 2010), is common on the bluff in the Abingdon Creek community. Only a small portion of this community is located within the transmission-line corridor (Gaddy 2010). Nerveless sedge ranges over much of eastern North America and its global conservation status rank is G4, apparently secure (NatureServe Explorer 2010). Thus, any impacts from installation of the transmission line would have a negligible effect on the species.

Wildlife

Wildlife present in the proposed two new transmission-line corridors during installation of the corridors and transmission-line structures would be subjected to many of the same types of impacts described for the Lee Nuclear Station site. Wildlife may suffer mortality, disturbance, and displacement as a result of forest clearing and building activities. Less mobile animals, such as reptiles, amphibians, small burrowing mammals, and unfledged birds, would incur greater mortality than more mobile animals, such as adult birds and large mammals. Disturbances at sublethal levels may adversely affect behaviors, such as movement, feeding, sheltering, and reproduction. Mobile animals may be displaced into nearby undisturbed forest habitat where increased competition for resources during transmission-line installation may result in increased predation and decreased fecundity, ultimately leading to temporary reductions in populations. Although a large area of forest (about 690 ac) would be affected, a relatively small portion of wetlands and stream riparian corridor would likely be affected because of the existing construction practices and BMPs noted above for these habitats. Thus, overall, it is anticipated that mortality, disturbance, and displacement would be incurred to a much greater extent for upland-forest species than for wetland or riparian species.

Species adapted to early successional habitat would be lost from the upland shrub/scrub habitats during corridor installation. Such species may disperse into shrub/scrub habitats in adjacent areas, and colonize new shrub/scrub habitats created by installation of the corridor. Similarly, species adapted to forest/clearing interface environments may be lost from edge habitats that are destroyed by forest clearing, but may disperse into edge habitats in adjacent areas and colonize new edge habitats created by corridor installation. Transmission-line corridors may be managed to provide substantial habitat for grassland birds, raptors, and small mammals by functioning as linear grasslands/shrublands in an otherwise forest-dominated landscape (see Section 5.3.1.2) (Duke 2012m). Thus, overall, transmission-line corridor installation could pose minor adverse effects or could be beneficial for some species that inhabit early successional habitat or use edge environments. However, species dependent on interior forests could only disperse into contiguous forest habitats, which are likely less prevalent in adjacent areas and are not created by installation of the corridor. Thus, forest-interior wildlife may be locally affected to a greater extent than wildlife adapted to early successional or forest-edge habitats. However, because only a relatively small portion (about 4 percent) of the forest habitat in the transmission-line-siting area would be used, forest-interior habitat availability in the siting area is not expected to be a factor limiting populations of affected forest-interior wildlife.

Noise levels associated with installation of the transmission lines are anticipated to be similar to or less than and of shorter duration than noise levels associated with building activities at the Lee Nuclear Station site. Thus, the impact on wildlife from installation noise is expected to be temporary and minor. The potential for traffic-related wildlife mortality is expected to be low because construction crews would be small and dispersed over very large geographic areas. Avian mortality resulting from collisions with structures and equipment during transmission-line installation would represent a negligible hazard for bird populations.

Vegetation clearing (including timber harvest) and grubbing would be scheduled, to the extent practical, to avoid the migratory bird-nesting season (generally March through June). However, if avoidance is not feasible, Duke would apply to amend its existing FWS and SCDNR depredation permits (MB000257-0 and MD-19-10, respectively) (Duke 2010d).

A general description of non-game wildlife known to occur in existing Piedmont transmission-line corridors largely follows that provided by Duke Power Company (1976) as referenced by Duke (2007c). Surrounding hardwood and mixed hardwood-pine forests, interspersed by pasture and fallow fields, provide suitable habitat for a number of wildlife species that would inhabit the transmission-line corridors and the edge habitat of such corridors created for Lee Nuclear Station. Grazed land is generally less suitable for wildlife because of the paucity of food and cover; however, the red fox (*Vulpes vulpes*), killdeer (*Charadrius vociferus*), and garter snake (*Thamnophis sirtalis*) are representative species for this habitat. The open areas and early successional areas (i.e., hayfields, fallow fields, clearcut areas, and existing ROWs) provide feeding areas for birds such as the eastern meadowlark (*Sturnella magna*), field sparrow (*Spizella pusilla*), barn swallow (*Hirundo rustica*), and eastern bluebird (*Sialia sialis*); small game such as cottontail rabbit (*Sylvilagus floridanus*), bobwhite quail (*Colinus virginianus*), and mourning dove (*Zenaida macroura*); and reptiles such as the black racer (*Coluber constrictor*), rough green snake (*Opheodrys aestivus*), and the broadhead skink (*Eumeces laticeps*). Other species in these habitats include the golden mouse (*Ochrotomys nuttali*) and the red-tailed hawk (*Buteo jamaicensis*). These areas provide food (e.g., seeds, insects, small prey) and essential cover. The field borders offer nesting habitat and escape cover for birds such as the Carolina wren (*Thryothorus ludovicianus*), cardinal (*Cardinalis cardinalis*), eastern towhee (*Pipilo erythrophthalmus*), song sparrow (*Melospiza melodia*), and mockingbird (*Mimus polyglottos*).

The hardwood and mixed pine-hardwood forests of the area offer habitat for gray squirrels (*Sciurus carolinensis*), white-tailed deer (*Odocoileus virginianus)*, and wild turkey (*Meleagris gallopavo*). Other representative species found in the forested areas include the southern flying squirrel (*Glaucomys volans*), white-footed mouse (*Peromyscus leucopus*), opossum (*Didelphis virginiana*), northern flicker (*Colaptes auratus*), red-eyed vireo (*Vireo olivaceus*), Carolina wren, great crested flycatcher (*Myiarchus crinitus*), eastern wood pewee (*Contopus virens*), black-and-white warbler (*Mniotilta varia*), indigo bunting (*Passerina cyanea*), eastern box turtle (*Terrapene carolina*), American toad (*Bufo americanus*), and black rat snake (*Elaphe obsoleta obsoleta*). The bottomlands adjacent to the major rivers provide habitat for beaver (*Castor canadensis)*, raccoon (*Procyon lotor*), mallard (*Anas platyrhynchos*), wood duck (*Aix sponsa*), Carolina chickadee (*Poecile carolinensis*), northern parula warbler (*Parula americana*), northern watersnake (*Natrix sipedon sipedon*), gray treefrog (*Hyla versicolor*), northern cricket frog (*Acris crepitans*), and green frog (*Rana clamitans melanota*) (Duke Power Company [1976] as referenced by Duke [2007c]).

Summary

Installation of the proposed two new transmission-line corridors would be done according to Federal and State regulations, permit conditions, and established BMPs. Wetlands and waterways would be avoided to the extent possible, and unavoidable impacts on jurisdictional wetlands would be compensated (see Section 4.3.1.7). Although a large quantity of upland-forest habitat would be lost locally and some direct wildlife mortality would be incurred, this represents a small portion of the upland-forest habitat and wildlife currently in the upstate Piedmont. Non-lethal wildlife disturbances and displacements, collisions with elevated structures, noise, and increased traffic would result in minor and temporary wildlife impacts. Therefore, the review team concludes that site-preparation and development-related impacts on habitat and associated wildlife in the proposed two new transmission-line corridors would be noticeable but not destabilizing.

4.3.1.4 Terrestrial Resources – Railroad Corridor

Existing Cover Types

Within the original 6.8-mi-long and 50-ft-wide railroad-spur corridor, all trees and shrubs previously had been cleared for the unfinished Cherokee Nuclear Station. Vegetation within the existing corridor currently consists mainly of grasses and forbs, with visible ongoing disturbance by off-road vehicles (Duke 2009c; Enercon 2008). The bed of the existing railroad spur would need to have additional vegetation cleared within the corridor and new ballast, rail ties, and rails installed to become operational for transporting materials and equipment to the Lee Nuclear Station site (Duke 2009b). Because the renovated railroad spur would be aligned along the existing corridor and the existing corridor has been maintained for off-road access to the surrounding area, only negligible impacts on upland habitat are anticipated (Duke 2009c).

An additional area of potential impact would include an approximately 1300-ft section of the railroad spur that would need to be rerouted just west of Reddy Ice, as described in Section 2.4.1.4 (Figure 2-6) (Duke 2010h). The rerouted portion of the railroad spur would negligibly affect habitat because one part is highly disturbed and provides little vegetative cover, another part would require cutting very few trees for railroad-spur refurbishment, and another part lies in an existing Duke transmission-line corridor where trees and shrubs are cut or sprayed every 5 years (Duke 2010c). Thus, only negligible impacts on habitat (approximately 0.5 ac of disturbance) are anticipated.

Duke anticipates requiring more "fill" material along the railroad corridor than will be generated by "cutting." It is anticipated that almost no spoil material will be left after renovation of the new railroad spur and the realignment (Duke 2009c). Thus, any habitat impacts from deposition of excess spoil would be negligible.

Wetlands, Streams, and Floodplains

Permanent and temporary impacts on jurisdictional wetlands would result from the replacement of culverts at London Creek. Permanent impacts would result from culvert placement. Temporary impacts would result from construction of temporary cofferdams and associated backwater flooding during a 10-year storm event. Thus, permanent filling (0.11 ac), temporary filling (0.06 ac), and temporary flooding (0.35 ac) would occur within jurisdictional wetlands. The Reddy Ice Plant realignment portion of the railroad corridor avoids impacts on jurisdictional wetlands. There would be no impacts (e.g., clearing riparian vegetation) on terrestrial resources associated with work that would be done adjacent to streams within the railroad corridor. It is not anticipated that any work would occur within 100-year floodplains; however, if work is required in such areas, potential floodplain impacts would be avoided as indicated below for offsite road improvements in Section 4.3.1.5 (Duke 2011h).

Since preparation of the draft EIS, Duke has designed a railroad turnaround north of Make-Up Pond B (Figure 3-4). Site-development impacts associated with the railroad turnaround are included in the discussion of permanent impacts on the Lee Nuclear Station site in Section 4.3.1.1 and in Table 4-1 under the general grading and transportation category. The current level of design for the railroad turnaround has no additional impacts on wetland or streams compared to the Federal permit application (Duke 2013d). In addition, as previously discussed in Section 4.3.1.1, to further protect adjacent waterbodies from indirect impacts during onsite construction activities, Duke intends to implement a 50-ft undisturbed buffer zone around all existing protected areas, including wetlands, open waterbodies, and streams (Duke 2013d).

Wildlife

Because of the poor habitat conditions within the existing railroad bed and the parallel margins along each side, impacts on mammals and birds are expected to be minor. However, the corridor itself is used by amphibians and reptiles (see Section 2.4.1.4) and provides ideal habitat for box turtles. The relatively open railroad bed contains dense vegetation, including species often consumed by box turtles, and the large puddles in the corridor provide water and prey (e.g., amphibian larvae) (Dorcas 2009c). This habitat would likely be destroyed during renovation of the railroad-spur corridor, and this may result in direct mortality or displacement of the species into surrounding areas over the length of the railroad-spur corridor. Although the conservation status of the box turtle in South Carolina has not been assessed, it is considered to be globally secure (global conservation status rank G5) over most of its range in the southeastern United States (NatureServe Explorer 2010).

Summary

The review team has determined that the impacts of habitat loss and wildlife mortality, disturbance, and displacement would be minor and temporary in nature. Proposed renovation of the railroad spur would be done according to Federal and State regulations, permit conditions, and established BMPs. Wetlands and waterways would be avoided to the extent possible, and unavoidable impacts on jurisdictional wetlands would be compensated (see Section 4.3.1.7). Therefore, the review team concludes that site-preparation and development-related impacts on habitat and associated wildlife from the proposed railroad-spur renovation and realignment would be negligible.

4.3.1.5 Offsite Road Improvements

The six areas that contain the nine offsite road-improvement locations occur in uplands, except for a regulatory 100-year floodplain associated with the Broad River in a portion of the SC 329/ US 29 intersection improvement. Offsite road-improvement effects associated with erosion and sedimentation during construction would be mitigated through implementation of SCDHEC and South Carolina Department of Transportation (SCDOT) BMPs. Because road improvements would be constructed to SCDOT standards to meet Federal Emergency Management Agency regulations (e.g., maintaining the regulatory floodway free of encroachment in order to avoid a more than 1-ft rise in the base flood elevation), no impacts on the Broad River floodplain associated with the SC 329/US 29 intersection improvement project are anticipated (Duke 2011h). Because no jurisdictional wetlands or streams occur in these six areas (Duke 2011h), there would be no impacts on jurisdictional wetlands or stream riparian areas from offsite road improvements. In addition, the offsite road improvements (e.g., ramp reconfigurations, additional turning lanes, new traffic signals) would result in negligible impacts on wildlife resources.

4.3.1.6 Important Terrestrial Species and Habitats

This section describes the potential impacts on important terrestrial species and habitats, including Federal candidate, proposed, and listed (threatened, or endangered) species; species ranked by the State of South Carolina as critically imperiled, imperiled, or vulnerable, some of which may also be designated as threatened or endangered by the State; and other important species described in Section 2.4.1.6. The potential impacts of site preparation and development at the Lee Nuclear Station site, the Make-Up Pond C site, the two new transmission-line corridors, and the railroad-spur corridor are described in the following sections.

In a letter dated April 9, 2008, the NRC requested that the FWS Field Office in Atlanta, Georgia, provide information regarding Federally listed, proposed, and candidate species and critical habitat that may occur in the vicinity of the Lee Nuclear Station site (NRC 2008e). On May 13, 2008, the FWS provided a response letter indicating three listed and one candidate species and no critical habitat in Cherokee, Union, and York Counties (FWS 2008a), which encompass Lee Nuclear Station site, the Make-Up Pond C site, the railroad-spur corridor, the two proposed transmission-line corridors, and the six offsite road-improvement areas (Table 2-9). These species include the pool sprite (*Amphianthus pusillus*), Georgia aster (*Symphyotrichum georgianum* [formerly *Aster georgianus*]), dwarf-flowered heartleaf (*Hexastylis naniflora*), and Schweinitz's sunflower (*Helianthus schweinitzii*). An additional listed species identified that may occur in the project area is the smooth coneflower (*Echinacea laevigata*) (Cantrell 2008). These species were surveyed and only the Georgia aster, a Federal candidate species, was observed on or in the vicinity of the project footprint (Make-Up Pond C study area [see Section 2.4.1.6]) and is, therefore, discussed in this section.

In a letter dated June 13, 2012, the FWS concurred with the review team's determination that the proposed Lee Nuclear Station Units 1 and 2 project (all elements) is not likely to adversely affect Federally protected species nor result in adverse modification to designated or proposed critical habitat, thus completing informal consultation between the FWS and NRC (FWS 2012b). Consultation correspondence between the review team and FWS is listed in Appendix F.

Lee Nuclear Station Site

<u>Loggerhead Shrike (*Lanius ludovicianus*) – State Vulnerable (S3)</u>

The loggerhead shrike (Table 2-9), is a year-round resident in the southeastern United States and likely inhabits Lee Nuclear Station year-round but is rare onsite (see Section 2.4.1.6). Suitable habitat for the shrike consists of grassland or other open habitat with scattered trees and thorny shrubs for foraging, nesting, and perching. Site preparation at the Lee Nuclear Station site would affect the onsite open/field/meadow and upland scrub habitats, but would have a negligible impact on the species in South Carolina. This species has a global conservation status rank of G4, apparently secure (NatureServe Explorer 2013).

<u>Southern Adder's-Tongue Fern (*Ophioglossum vulgatum*) – State Imperiled (S2)</u>

A population of 25 southern adder's-tongue fern was identified during a 2006 field survey (Duke 2009c) and verified in 2013 (Duke 2013d). This population occurs in a ravine in the southwestern portion of the Lee Nuclear Station site (Duke 2009c) now designated for placing a spoil area (Duke 2013d). Southern adder's tongue fern also occurs within the proposed Make-Up Pond C site (Gaddy 2009), the proposed transmission-line corridors (Gaddy 2010), and the Kings Mountain National Military Park located about 10 mi northeast of the Lee Nuclear Station site (White and Govus 2005).

Duke would coordinate with the SCDNR regarding potential mitigation measures, but no plans or commitments have been developed to relocate this population (Duke 2013d). Because the species occurs elsewhere in Cherokee County and 16 other counties in South Carolina and has a global conservation status rank of G5, secure (NatureServe Explorer 2013), the loss of this population would have a negligible impact overall on the species.

No Federally threatened, endangered, proposed, or candidate animal or plant species or species ranked by the State of South Carolina as critically imperiled, imperiled, or vulnerable are known to occur on the Lee Nuclear Station site (Table 2-9). No important habitats exist on the Lee Nuclear Station site that were not discussed previously (e.g., wetlands in Section 4.3.1.1).

Make-Up Pond C Site

<u>Loggerhead Shrike (*Lanius ludovicianus*) – State Vulnerable (S3)</u>

The loggerhead shrike occurs near the Make-Up Pond C study area where it is likely an uncommon year-round resident (see Section 2.4.1.6). Site-preparation and development activities would affect open/field/meadow and upland scrub habitats that are available in the Make-Up Pond C study area, and could potentially inundate any nests of the species. However, because of the species' year-round residence in the southeastern United States, its rarity in the project area, and the abundance of open habitat outside the Make-Up Pond C study area, site-preparation and inundation activities would have a negligible impact on the species.

<u>Georgia Aster (*Symphyotrichum georgianum* [formerly *Aster georgianus*]) – Federal Candidate Species and State Unranked (SNR)</u>

Georgia aster occurs in about 126 extant populations in the southeastern United States, and in 15 counties in South Carolina (including Cherokee County). Its global conservation rank status is G3, vulnerable (NatureServe Explorer 2013). Most of these populations are small, consisting of stands of only 10 to 100 stems but a few have around 1000 stems. These plants are primarily reproducing non-sexually, by means of rhizomes, so each population probably represents just a few genotypes (FWS 2010a; NatureServe Explorer 2013). The greatest threat to the species is the destruction, modification, or curtailment of its habitat (formerly post oak [*Quercus stellata*] savanna/prairie, currently dry oak-pine flatwoods, and open uplands) or range (FWS 2010a). The species occurs within mowed power-line ROWs in Kings Mountain National Military Park located about 10 mi northeast of the Lee Nuclear Station site (White and Govus 2005).

The Georgia aster (Table 2-9) is also located in a transmission-line corridor in the Make-Up Pond C study area. The population is small, consisting of 14 stems in 2009 (see Section 2.4.1.6), and would be destroyed by reservoir development. The inundation of Make-Up Pond C also would destroy suitable habitat for the species (i.e., in the transmission-line corridor where the species was found). Because the species occurs elsewhere in Cherokee County and in 14 other counties in South Carolina, the destruction of this population would represent only relatively minor curtailment of the species' range and habitat. Thus, impacts on the species overall would be minor.

Drooping Sedge (*Carex prasina*) – State Imperiled (S2)

Drooping sedge is distributed over most of the eastern United States and Canada, and is known to occur in three counties in South Carolina (NatureServe Explorer 2013). Drooping sedge is found in the Make-Up Pond C study area (see Section 2.4.1.6). The species was not previously known to occur in Cherokee County, and this occurrence would be lost with creation of Make-Up Pond C. Because the species occurs in three other counties (Oconee, Pickens, and Union) in South Carolina and is widely distributed elsewhere in eastern North America, where it is considered to be apparently secure throughout most of its range (global conservation status rank, G4) (NatureServe Explorer 2013), the loss of this population would have a negligible impact overall on the species.

Southern Enchanter's Nightshade (*Circaea lutetiana* ssp*. canadensis*) – State Vulnerable (S3)

Southern enchanter's nightshade is distributed over most of the eastern United States and Canada, and is known to occur in seven counties, not including Cherokee County, in South Carolina (NatureServe Explorer 2013). The species occurs in Kings Mountain National Military Park located about 10 mi to the northeast of the Lee Nuclear Station site (White and Govus 2005). Southern enchanter's nightshade is found in the Make-Up Pond C study area (see Section 2.4.1.6). The species was not previously known to occur in Cherokee County, and this occurrence would be lost with creation of Make-Up Pond C. However, because the species occurs in seven other counties in South Carolina and is widely distributed elsewhere in eastern North America, where it is considered to be secure throughout its range (global conservation status G5T5, secure) (NatureServe Explorer 2013), the loss of this population would have a negligible impact overall on the species.

Southern Adder's-Tongue Fern (*Ophioglossum vulgatum*) – State Imperiled (S2)

Southern adder's-tongue fern is distributed over most of the eastern United States and Canada and is known to occur in 17 counties, including Cherokee County, in South Carolina (NatureServe Explorer 2013). The species occurs in Kings Mountain National Military Park located about 10 mi to the northeast of the Lee Nuclear Station site (White and Govus 2005). Southern adder’s-tongue fern also occurs on the Lee Nuclear Station site (Duke 2009c) and has been identified in three locations along the proposed transmission-line corridors (Gaddy 2010). Its occurrence in the Make-Up Pond C area would be lost with creation of the reservoir. However, because the species occurs elsewhere in Cherokee County, in 16 other counties in South Carolina, and is widely distributed elsewhere in eastern North America, where it is considered to be secure throughout its range (global conservation status rank G5) (NatureServe Explorer 2013), the loss of this population would have a negligible impact overall on the species.

<u>Canada Moonseed (*Menispermum canadense*) – State Imperiled (S2)</u>

Canada moonseed is distributed over most of the eastern United States and Canada and is known to occur in 16 counties, including Cherokee County, in South Carolina (NatureServe Explorer 2013). The species occurs in Kings Mountain National Military Park located about 10 mi to the northeast of the Lee Nuclear Station site (White and Govus 2005). Its occurrence at Make-Up Pond C would be lost with creation of the reservoir. However, because the species occurs in 16 counties in South Carolina and is widely distributed elsewhere in eastern North America, where it is considered to be secure throughout its range (global conservation status rank G5) (NatureServe Explorer 2013), the loss of this population would have a negligible impact overall on the species.

<u>Single-Flowered Cancer Root (*Orobanche uniflora*) – State Imperiled (S2)</u>

Single-flowered cancer root is distributed over the entire United States and southern Canada and is known to occur in six counties, not including Cherokee County, in South Carolina (NatureServe Explorer 2013). The species occurs in Kings Mountain National Military Park located about 10 mi to the northeast of the Lee Nuclear Station site (White and Govus 2005). Single-flowered cancer root was not previously known to occur in Cherokee County, and its occurrence would be lost because of development of Make-Up Pond C. However, because the species occurs in six other counties in South Carolina and is widely distributed across much of North America, where it is considered to be secure throughout its range (global conservation status rank G5) (NatureServe Explorer 2013), the loss of this population would have a negligible impact overall on the species.

No other Federally threatened, endangered, proposed, or candidate animal or plant species or species ranked by the State of South Carolina as critically imperiled, imperiled, or vulnerable are known to occur in the Make-Up Pond C study area. No important habitats exist in the Make-Up Pond C study area that were not discussed previously (e.g., wetlands in Section 4.3.1.2).

Transmission-Line Corridors

<u>Loggerhead Shrike (*Lanius ludovicianus*) – State Vulnerable (S3)</u>

The loggerhead shrike likely inhabits the proposed transmission-line corridors, based on the presence of suitable habitat (see Section 2.4.1.6) and the occurrence of this species in nearby parts of the project area (see above). Impacts on the loggerhead shrike in the proposed transmission-line corridors would be similar to those described above for Lee Nuclear Station and Make-Up Pond C, and would be negligible or minor in nature.

Southern Adder's-Tongue Fern (*Ophioglossum vulgatum*) – State Imperiled (S2)

Southern adder's-tongue fern occurs at three locations—two locations along the proposed east transmission-line corridor (Route O) and one location along the proposed west transmission-line corridor (Route K) (see Section 2.4.1.6) (Gaddy 2010). Impacts on this species from installation of the transmission-line corridors would be similar to those described above for the Lee Nuclear Station site and Make-Up Pond C and would be negligible or minor in nature.

No other Federally threatened, endangered, proposed, or candidate animal or plant species or species ranked by the State of South Carolina as critically imperiled, imperiled, or vulnerable are known to occur within the two transmission-line corridors. No important habitats exist in the transmission-line corridors that were not discussed previously (e.g., wetlands in Section 4.3.1.3).

Railroad Corridor

No Federally threatened, endangered, proposed, or candidate animal or plant species or species ranked by the State of South Carolina as critically imperiled, imperiled, or vulnerable are known to occur within the railroad-spur corridor. No important habitats exist in the railroad-spur corridor (see Section 4.3.1.4).

Offsite Road Improvements

As previously mentioned in Section 2.4.1.6, no Federally listed, proposed, or candidate species or State-ranked species have been documented by the FWS or the SCDNR as occurring within the six offsite road-improvement areas (Duke 2011h).

Other Important Species

Commercially and Recreationally Valuable Species

Commercially and recreationally valuable species include mammalian and avian game species, all of which are common in the project area vicinity (see Section 2.4.1.6). Thus, the impacts on such species from site preparation and development of the proposed Lee Nuclear Station, the Make-Up Pond C site, the two new transmission-line corridors, and railroad-spur corridor would be negligible to minor.

Invasive Species

The mixed hardwood community herbaceous layer on the north side of the Lee Nuclear Station site is occupied by Japanese honeysuckle (*Lonicera japonica*), an introduced species that is a common invasive in much of the southern and eastern United States (see Section 2.4.1.1). Because the mixed hardwood forest on the north side of the site would be disturbed, by site preparation and development, there would be potential for the spread of Japanese honeysuckle vegetatively via deposition of roots or rhizomes in spoils into disturbed areas or via natural dispersal of seeds by birds.

Although 20 (about 5 percent) of the 426 plant species identified within the Make-Up Pond C study area were exotics or invasives, the more common invasive plant species (Chinese privet [*Ligustrum sinense*], autumn olive [*Elaeagnus umbellata*], Japanese honeysuckle, and Vietnam grass [*Microstegium vimineum*]) were scarce (see Section 2.4.1.2). In addition, most of the disturbance in the Make-Up Pond C study area would arise from inundation, which is a relatively ineffective vector for the spread of noxious weeds. However, there would be potential for the spread of exotics via deposition of seed in spoils into disturbed areas or natural colonization of disturbed areas by exotics. This could occur in spoil areas (Figure 3-5) that would replace pine and hardwood forest outside of the inundation zone (Figure 2-14), and as a result of the use of borrow soils taken from within the impoundment area prior to inundation (Duke 2009b).

4.3.1.7 Compensatory Mitigation and Monitoring

Waters of the United States

Duke would use the mitigation sequence of avoidance, minimization, and compensation to mitigate impacts on waters of the United States (wetlands and streams) for the proposed Lee Nuclear Station. Avoidance of wetlands and streams would be accomplished by siting facilities outside the areas of potential effect on these resources (e.g., river water intake pipeline in the uplands adjacent to rather than through the forested wetland along the Broad River [see Section 4.3.1.1], siting transmission-line structures outside of stream buffers and wetlands [see Section 4.3.1.3]), and renovating existing facilities where possible instead of building them anew (e.g., renovation of the existing railroad-spur corridor [see Section 4.3.1.4]). Minimization of impacts would be accomplished by using BMPs to control erosion and convey sediment away from wetlands and streams, and by implementing a SWPPP.

Unavoidable impacts on wetlands and streams would be mitigated through compensatory mitigation. Duke has consulted with the USACE to develop a compensatory mitigation plan in conformance with the requirements of the USACE Charleston, South Carolina District's *Guidelines for Preparing a Compensatory Mitigation Plan, Working Draft* (USACE 2010a) and *Compensatory Mitigation for Losses of Aquatic Resources; Final Rule* (73 FR 19594, 40 CFR Part 230 and 33 CFR Part 332). A watershed-based, permittee-responsible mitigation project or projects, including restoration, preservation, and enhancement, would be used to compensate for unavoidable project impacts on wetlands and streams. A watershed-based mitigation approach may provide substantial ecological benefit, such as conservation of relatively large tracts of land comprising wetlands, riparian corridors, and uplands (Duke 2010t).

Based on Federal law (Section 404 CWA), the prescriptive nature of compensatory mitigation regulations for wetlands and streams (40 CFR Part 230; 33 CFR Part 332; USACE 2010a), and the approach described above, there is a reasonable assurance that any unavoidable impacts on wetlands and streams on the Lee Nuclear Station site, along the two new transmission-line corridors, in the Make-Up Pond C study area, and in the railroad-spur corridor (there are no jurisdictional wetlands or streams in the offsite road-improvement areas [see Section 4.3.1.5]) would be compensated. The details of the mitigation plan are summarized below. Note that there is no State statutory or regulatory nexus and no regulatory prescriptions for mitigating the loss of the seven significant natural areas, some of which may represent three South Carolina ecological associations of concern; four noteworthy ecological associations of concern to the State of South Carolina; and associated occurrences of five uncommon plant species (described in Section 4.3.1.2) in the Make-Up Pond C study area.

Credit Determination

The USACE Charleston District Guidelines were used to calculate the credits needed to provide compensatory mitigation for unavoidable impacts from the construction of the Lee Nuclear Station and the proposed drought contingency pond. Baseline data for affected wetland, stream, and open water resources can be found in Volume 1, Part II, Section 6.0 of the Federal Permit Application (Duke 2011h), and Sections 2.3 and 2.4 of the ER (Duke 2009c) and ER Supplement (Duke 2009b). The USACE Charleston District Guidelines provide separate processes for calculating the required mitigation credits for wetlands (including open-water habitats) and streams. Functional assessments were conducted in the field to determine the existing conditions of wetlands and streams for use in the calculation of required mitigation credits. Based on this methodology, the total mitigation credit needs for Lee Nuclear Station are 54 wetland credits and 484,000 stream credits. Thus, stream impacts play the important role in the mitigation site selection and approach.

Site Selection

Beginning in March 2009, Duke began the search for mitigation options. After confirming that available mitigation banks have inadequate numbers of credits available, Duke investigated existing in-lieu-of-fee programs in the Broad River watershed. None existed at the time, nor are any currently available. Because there were insufficient mitigation bank credits available and no in-lieu-of-fee programs, Duke began an outreach to stakeholders for input on possible appropriate, watershed-based, permittee-responsible mitigation projects. On March 22–23, 2010, Duke held a 2-day interagency meeting in Gaffney, South Carolina, to discuss possible mitigation approaches. Duke also reached out to non-governmental stakeholder organizations and local government officials as well as other Federal agencies such as the Natural Resources Conservation Service.

Construction Impacts at the Lee Nuclear Station Site

The proposed Lee Nuclear Station, including the two new transmission-line corridors, spans the upper and lower Broad River watersheds in the Santee River Basin (Duke 2010o) and the Kings Mountain and Southern Outer Piedmont subdivisions of the Piedmont ecoregion (EPA 2007a). As part of a watershed-based approach to compensatory mitigation, and in an effort to perform compensatory mitigation as close as possible to where impacts would occur (USACE 2010a; 33 CFR Part 332), Duke conducted a wide search for appropriate large-scale mitigation properties in the South Carolina portion of the upper and lower Broad River watersheds (hydrologic unit codes 03050105 and 03050106, respectively) within the Kings Mountain and Southern Outer Piedmont ecoregion subdivisions (Duke 2010t). Through discussions with the USACE, Duke evaluated mitigation opportunities at the U.S. Forest Service (USFS), Sumter National Forest, Enoree District. The USFS Enoree District had identified in its forest management plans the need for restoration in areas of the forest affected by historic farming and agricultural practices that had resulted in significant sediment buildup and the creation of a deep-gully landscape.

Mitigation Approach

The mitigation plan includes the purchase of mitigation bank credits (purchased from USACE-approved mitigation banks) as well as permittee-responsible mitigation using a watershed approach. The plan uses large-scale mitigation opportunities that would create benefits within watersheds similar to those in the London Creek watershed affected by the creation of Make-Up Pond C, where the majority of stream impacts would occur. Through a proposed public/private partnership with the USFS, Duke Energy proposes the restoration and enhancement of a network of streams within the Lower Broad River watershed in the Sumter National Forest (Figure 4-1).

The first component of the mitigation plan, the Woods Ferry study area (Duke 2011h), which comprises more than 11,600 ac of contiguous forest located in Chester County in the northeast corner of the USFS Enoree Ranger District , was identified as a unique opportunity to provide wetland and stream mitigation at a landscape level. Streams in the Woods Ferry study area have incised or cut through deep layers of floodplain sediment to historic elevations, and are now entrenched and laterally unstable. This instability results in increased sediment loads, degraded water quality, poor in-stream habitat, reduced water storage and base flow release, and diminished water availability for the riparian plant community.

The proposed restoration and enhancement of streams in the Woods Ferry study area would improve these degraded aquatic stream functions. These streams occur in a watershed similar to that of London Creek. Stream restoration in Sumter National Forest supports the USFS in meeting the needs identified in its Forest Management Plan to restore the functions of aquatic resources (e.g., stabilizing stream bank erosion and improving habitat for fish and macro-benthic communities) for public benefit.

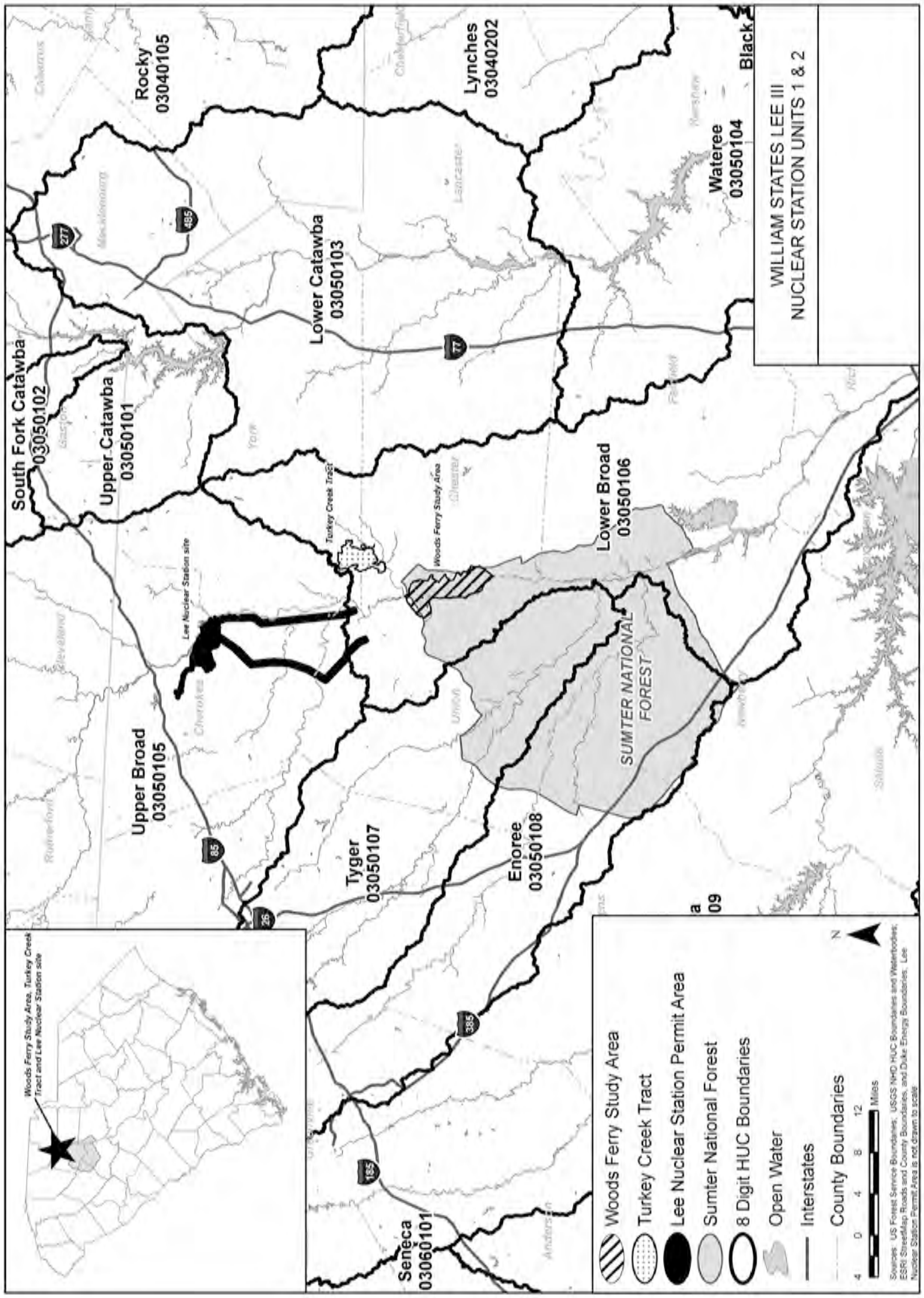

Figure 4-1. Woods Ferry Study Area and Vicinity (USACE 2013b, modified from Duke 2011h)

The second component of the mitigation plan is the Turkey Creek Tract, a large privately owned property in the Sumter National Forest located near the Woods Ferry study area. The Turkey Creek Tract offers an opportunity for mitigation that is substantial enough to provide regional benefits in the form of preservation and buffer enhancement.

Stream Restoration

The mitigation plan proposes primarily Priority 2 stream restoration (Rosgen 1997) for restoring the stream impairments typically found within Woods Ferry. Priority 2 restoration involves excavation to re-establish a functional floodplain along an existing stream channel elevation. This serves to reconnect a floodplain to a stream by reestablishing characteristic bankfull dimensions (defined as stream channel widths at which overbank flow begins during a flood) and flood frequency. This is accomplished by restoring stable stream dimension (cross-sectional area), pattern (view of a stream channel from above), and profile (longitudinal slope).

This approach would convert the existing degraded channels (Rosgen F and G channel types) to more functional channels (Rosgen C, B, and E channel types) by establishing new, stable stream beds (i.e., that neither degrade [incise] nor aggrade [rise due to excessive sediment deposition]) and floodplains without requiring extensive downstream grade controls (Rosgen 1997). Restoration of stable stream physical characteristics would reduce sediment in onsite and downstream receiving waters by removing legacy sediments from the floodplain, stabilizing eroding streambanks, and restoring forested riparian buffers. Construction would target installation of the most appropriate natural channel design to a particular stream reach. This is accomplished by excavating the floodplain, removing legacy sediment, and establishing the belt width of that floodplain at current stream elevations. After excavation of legacy sediment and establishment of the natural channel design, the riparian community along streams would be replanted and reestablished. Bridges and culverts in the restoration area would be replaced to accommodate the larger floodplains. Floodplains and upland slopes adjacent to streams would be re-vegetated.

This hydrological restoration will improve in-stream habitat by reducing sedimentation and enhancing stream bed variability. The restoration efforts have the potential to provide up to an estimated 85,388 linear ft of restored streams in the Woods Ferry area of the Sumter National Forest.

Baseline Information

Baseline data for the Woods Ferry study area and the Turkey Creek Tract are found in the Federal permit application (Duke 2011h). Part III C and Part III D contain details of topography, land use, soil types, hydrology, plant communities, and water quality and existing stream conditions for these areas. The Woods Ferry study area and Turkey Creek Tract exhibit landscape and habitat characteristics similar to the London Creek drainage, although areas of

Woods Ferry are more deeply incised and eroded. Collection of field baseline data for the proposed mitigation areas is ongoing, and includes installation of stream gages, Bank Erosion Hazard Index analysis and mapping, and surveying of each stream reach. General biological surveys (including fish, macroinvertebrates, and amphibians), rare, threatened and endangered species surveys, and water-quality data collection are included in the baseline data.

Monitoring

Constructed streambanks would be monitored and assessed for their stability, stream physical performance standards, including two bankfull flow events, channel stability analysis (such as Bank Erosion Hazard Index) ratings, bank pin installation, bank profile surveys, channel pattern and longitudinal survey, and stream bed material analysis. Post-restoration channel stability and bank erosion monitoring results will be compared to mitigation area pre-restoration data to determine the improvement in channel stability and decreased streambank erosion. Reference stream and associated baseline data will be used to establish performance standards for evaluating streambank and stream bed erosion rates. Physical changes in stream geomorphology are related to aquatic fauna communities. Stream aggradation, degradation, and enlargement affect in-stream habitats (i.e., pool size and frequency) and species diversity. Biological monitoring will be used to compare post-restoration data with reference stream baseline data. Biological monitoring will include changes in the benthic macroinvertebrate community, ambient water-quality monitoring, and fish sampling. Photograph reference stations will be established at locations along the restored streams, including cross sections and bank vegetation monitoring plots. Photographs will be compared from year to year and used to qualitatively evaluate channel aggradation or degradation, bank erosion, growth and survival of riparian vegetation, and effectiveness of erosion-control measures. Performance standards will be established for riparian vegetation community development.

A monitoring report documenting the stream restoration construction work will be completed within 90 days of the completion of vegetation planting. The baseline monitoring report will detail restoration activities, identify success criteria and monitoring plan components, and provide supporting information and data, including drawings, site photographs, permanent stream transect locations, sampling plot locations, a description of initial species composition by community type and density, and monitoring station locations. The report will also describe mitigation site maintenance and repair requirements and contingencies. The 5-year monitoring program will be implemented at the beginning of the first growing season after construction. The monitoring program is designed to document both stream and plant community development and progress toward achieving the performance standards. Annual monitoring reports will be prepared by the end of each calendar year following the guidelines issued for monitoring requirements in the USACE Regulatory Guidance Letter No. 08-03 (USACE 2008). The annual report will be submitted to the USACE by December 31 of the year during which the monitoring was conducted. The fifth (or final) report will include a Summary Report that provides an assessment of the entire 5-year monitoring period.

Adaptive Management

After restoration activities are completed, and annually during the 5-year monitoring period, the restored mitigation sites would be evaluated and their conditions documented in writing, graphics, and photographs. A report would be prepared. The focus will be on success as well as identification of any bank instability, in-stream structure failure, unsuccessful vegetation establishment, wildlife management issues (e.g., deer eating new plantings), or vandalism. If the mitigation or a specific component of the mitigation fails to achieve the defined success criteria, Duke would develop necessary adaptive management plans and/or implement appropriate remedial actions for the project in coordination with the USACE and the review agencies. Required remedial action, if any, would be designed to achieve the success criteria, and would include a work schedule and monitoring plan that would take into account physical and climatic conditions, including any conditions that may have contributed to failure.

Site Protection

As specified in 40 CFR 230.97 Management (a)(4) for mitigation on public lands, long-term protection of the Woods Ferry mitigation site would be provided through a Conservation Land Use Agreement between the USFS and the USACE. Site protection for the Turkey Creek Tract would be provided through use of a conservation easement using the Charleston District Conservation Easement Model (USACE 2010b). Duke will demonstrate financial assurance for completion of the mitigation project to the USACE Charleston District Engineer.

Federally Listed and State-Ranked Plant Species

A population of Georgia aster, a Federal candidate species, and populations of five plant species ranked by the State of South Carolina as imperiled or vulnerable (drooping sedge, southern enchanter's nightshade, southern adder's-tongue fern, Canada moonseed, and single-flowered cancer root) (see Sections 2.4.1.6 and 4.3.1.6) are located in the Make-Up Pond C study area. A population of southern adder’s-tongue fern is also located on the Lee Nuclear Station site. Duke would coordinate with the FWS for the Georgia aster and with the SCDNR for the five State-ranked species regarding the potential relocation of any populations that may be affected by site-development activities. Duke is considering the following conceptual approaches:

1. Transplant the populations of the five State-ranked species to species-specific suitable habitats in a mitigation area for the Make-Up Pond C site (not yet identified), if such habitats exist.

2. Relocate the Georgia aster population to a nearby site where a different occurrence of the species was discovered during a recent botanical survey. This newly found site supports four Georgia aster plants and appears to have the preferred soil type for the species (clay with relatively high levels of calcium and magnesium).
3. Relocate the Georgia aster population and populations of the five State-ranked species to recognized botanical gardens in Greenville or Gaffney, South Carolina, or near Charlotte, North Carolina (Duke 2010d, 2012j, 2013d).

Mitigation measures for site-preparation and development-related terrestrial impacts include the implementation of avoidance and minimization measures and BMPs described in Sections 4.3.1.1 through 4.3.1.5. No other mitigation or related monitoring is currently being considered by Duke for site-development impacts at the Lee Nuclear Station site, or within the Make-Up Pond C study area, the two proposed new transmission-line corridors, the railroad-spur corridor, or offsite road-improvement areas.

4.3.1.8 Summary of Impacts on Terrestrial Resources

Duke has indicated that site preparation and development for the Lee Nuclear Station site and vicinity, the Make-Up Pond C site, two new transmission-line corridors, the existing railroad-spur corridor, and offsite road improvements would be conducted according to Federal and State regulations, permit conditions, and established BMPs. Duke stated that it would work with the USACE to determine appropriate mitigation through the permitting process of Section 404 of the CWA (33 U.S.C. 1344), which prohibits the discharge of dredged or fill material into waters of the United States without a Department of the Army permit. Based on information provided by Duke and the review team's independent evaluation, the review team has determined that the site-preparation and development-related impacts on terrestrial habitats at the Lee Nuclear Station site (Section 4.3.1.1), including permanent or temporary losses of forests (approximately 423 ac cleared), jurisdictional wetlands (0.21 ac of forested wetlands hand-cut), and non-jurisdictional features (9.25 ac of water-filled depressions filled), as well as the temporary drawdown of 5.46 ac of jurisdictional wetlands during an approximate 3-year intake/refill structure installation period on the Lee Nuclear Station site, would be spatially extensive and would considerably alter the terrestrial ecology of the local landscape. The associated impact on wildlife would also be considerable, but impacts on two State-ranked species would be negligible.

Site preparation and development of the proposed two new transmission-line corridors would permanently disturb about 690 ac of upland-forest habitat in Cherokee and Union Counties and 1.15 ac of jurisdictional wetlands. Some direct wildlife mortality would be incurred and a small portion of one significant natural area would be disturbed. Employment of BMPs for transmission system installation would serve to minimize potential impacts on about 7.6 mi of streams, 116 stream crossings, and about 11 ac of jurisdictional wetlands. Based on information provided by Duke and the review team's independent evaluation, the review team has determined that the site-preparation and development-related impacts on terrestrial habitats along the two new transmission-line corridors, including disturbance of forests and wetlands, as described in Section 4.3.1.3, would serve to further fragment forest communities and would constitute a noticeable change to the terrestrial habitats of the surrounding landscape. The associated impact on general wildlife would also be noticeable, but impacts on two State-ranked species would be negligible.

As described in Sections 4.3.1.4 and 4.3.1.5, the site-preparation and development-related impacts on terrestrial habitats along the railroad-spur corridor and at the proposed offsite road-improvement areas would be localized and would not noticeably alter the terrestrial ecology of the surrounding landscape. The associated impact on wildlife would be negligible.

The proposed Make-Up Pond C would be the largest reservoir to be permitted in the State of South Carolina since the creation of Lake Russell in 1984. Site preparation and development and inundation of Make-Up Pond C would permanently alter the nature of the terrestrial habitat and wildlife resources in the London Creek watershed (Section 4.3.1.2). Creation of Make-Up Pond C would affect about 821 ac of forest (of which about 545 ac are relatively undisturbed mixed hardwood and mixed hardwood-pine forest) along most of the length of London Creek and its tributaries. Development of Make-Up Pond C would inundate seven significant natural areas, four noteworthy ecological associations of concern to the State, occurrences of five uncommon plant species, diverse amphibian and reptile assemblages, 3.55 ac of jurisdictional wetlands, and vegetation along 884 linear ft of jurisdictional streams. Creation of Make-Up Pond C would also alter the functionality of the London Creek corridor as a wildlife travel corridor, particularly for neotropical migrant songbirds of conservation priority. Development of Make-Up Pond C would disturb one occurrence each of a Federal candidate plant species, four State-ranked plant species, and multiple occurrences of a fifth State-ranked plant species and one State-ranked avian species. However, the potential impacts on these species range-wide would be minor, and Duke has stated it would coordinate with the FWS and the SCDNR regarding the potential relocation of any plant populations that may be affected by site-development activities. The abundance of watersheds of similar size in the upstate Piedmont that support similar high-value resources, either individually or collectively, is uncertain. Based on information provided by Duke and the review team's independent evaluation, the review team has determined that site preparation and development and inundation of Make-Up Pond C would constitute a noticeable change to the terrestrial habitats and wildlife communities of the surrounding landscape, and some important attributes of these resources would be permanently lost.

Based on information provided by Duke and the review team's independent evaluation, the review team concludes that the construction and preconstruction impacts for Lee Nuclear Station and vicinity, including the Lee Nuclear Station site and the proposed Make-Up Pond C, and offsite infrastructure areas, including the two new transmission-line corridors, the railroad spur, and offsite road improvements would be MODERATE. This impact level is primarily driven by the impacts at Make-Up Pond C and in the transmission-line corridors, all of which are related to site-preparation and development activities, not NRC-authorized construction. In consultation with the USACE, Duke is designing compensatory mitigation appropriate to offset impacts on wetlands, streams, and other waters of the United States within the jurisdiction of the CWA.

All of the NRC-authorized construction actions would occur in areas disturbed as part of site preparation and development for the Lee Nuclear Station. Therefore, the NRC staff concludes that the terrestrial ecological impact associated with NRC-authorized construction activities for both the site and vicinity and the offsite infrastructure areas would be SMALL, and no further mitigation would be warranted.

4.3.2 Aquatic Impacts

Aquatic resources in the Broad River and Ninety-Nine Islands Reservoir would be affected mainly by building the new cooling-water intake and discharge systems. Make-Up Pond A and Make-Up Pond B would be affected mainly by dredging and other soil-disturbing activities during modification of structures in the ponds. In addition, water would be drawn down in Make-Up Ponds A and B for an extended period while the temporary cofferdams are in place, which would affect aquatic species in the littoral zone. Aquatic impacts within the Lee Nuclear Station site include permanent (9.37 ac) and temporary (2.68 ac) impacts on 12.05 ac of open water (part of the 29.63 ac of open water impacts in Table 9-19 and an additional 92 ac of temporary open water impacts associated with the approximate 3-year-long intake/refill structure installation in Make-Up Ponds A and B (Duke 2012n, o). There would be no impacts to streams at the Lee Nuclear Station site (Duke 2012n).

Aquatic resources in London Creek and its unnamed tributaries would be affected mainly by breaching and draining the farm ponds, installing a dam across London Creek, and subsequently impounding the creek and filling the Make-Up Pond C reservoir. Installation of pump stations and an intake/discharge facility at Make-Up Pond C would have lesser impact because they would be installed prior to filling the reservoir. Aquatic impacts within the Make-Up Pond C site include permanent impacts on 17.58 ac of existing open water and 64,911 linear ft of stream and temporary impacts on 884 linear ft of stream (Duke 2012n).

There also would be minor offsite impacts on aquatic resources associated with renovating the railroad-spur culvert crossing (Duke 2012n).

4.3.2.1 Aquatic Resources – Site and Vicinity

Broad River

Installation activities associated with the cooling-water intake and discharge structures would result in the loss, both temporarily and permanently, of aquatic habitat in the Broad River. As stated in Duke's ER, all work would be conducted in accordance with the appropriate permitting agencies and authorizations, including the following:

- USACE – A Department of the Army permit for the discharge of dredged and/or fill material into waters of the United States.
- CWA – Section 401 water-quality certification for ensuring water-quality standards are met.
- SCDHEC – NPDES stormwater permit for surface-water discharges associated with land disturbance and industrial activity. This permit requires Duke to have an Erosion Control Plan in place before excavation, as well as an SWPPP.
- FWS – Consultation on the potential for activities to affect Federally listed aquatic species.
- SCDNR – Consultation on the potential for activities to affect State-ranked aquatic species.

<u>Broad River Intake Structure</u>

Installation of the Broad River intake structure will require in-water activities that would permanently disturb 0.54 ac (0.48 ac dredging, 0.06 ac filling for intake structure construction) of the Broad River bottom (Duke 2009c, 2012n). A cofferdam composed of two banks of Z-shaped sheet piles with gravel ballast in-fill (approximately 258 ft long and extending 75 ft into the river at the narrowest width of the river) would enclose the intake structure work area (Duke 2010f). The area inside the cofferdam then would be dewatered so that building activities could proceed in a dry environment. The cofferdam would reduce the potential for erosion and sedimentation, thus minimizing impacts on aquatic organisms in the river and their habitat from the depositing or shifting of sediment. Duke expects work on the intake structure to last approximately 20 months (Duke 2010f). Installation and removal of a cofferdam would be timed to minimize impacts on migratory fish spawning and on aquatic habitat in general. Five months would be needed to install the cofferdam assembly and another three months to remove it. Sediment disturbance from installation of the intake would be limited to areas inside the cofferdam during this period. Leakage through the cofferdams would be pumped through a sock filter and then discharged back into the river. A turbidity screen placed in the river would also be used to minimize turbidity levels (Duke 2011h). Once the project is built, the cofferdam would be removed behind a weighted silt curtain to protect the river from excess silt load during removal. Removal would occur prior to high flows in the spring.

Fish trapped in the cofferdam area should be relocated to the river prior to dewatering. Except for a small proportion of fish that could be lost due to handling stress, fish removal from the cofferdam area is expected to produce only minor, temporary impacts on those fish. Other fish could be adversely affected when sediments are suspended during the installation and removal of the sheet pilings and cofferdam and during startup of the intake system. While in place, the cofferdam is expected to reduce the width of the river from approximately 240 ft to 165 ft (Duke 2009c). This decrease in width would increase the velocity of the river in the vicinity of the installation site and thus increase the potential for bottom scour and bank erosion. After removal of the cofferdam, water velocities would return to normal, and eventually, the river bottom would be expected to fill in and return to conditions that existed before installation of the cofferdam. Because only one-third of the river width would be affected by the cofferdam installation, fish would have many opportunities to avoid a potential sediment plume.

The larvae of important fish species described in Section 2.4.2 were much more abundant in the backwater areas of the river above Ninety-Nine Islands Dam than in the area near the proposed Broad River intake structure, thereby reducing the potential for impact on larvae (Olmsted and Leiper 1978). Because spawning takes place largely outside the area near the intake structure and because installation and removal of the cofferdam will be timed, to the extent practicable, to occur outside the typical spawning season, it is therefore unlikely that impacts from building the Broad River intake structure in the mainstream portion of the reservoir would significantly alter fish reproduction in the Broad River. Each of these potential impacts is temporary and could be managed to limit the extent and magnitude of impacts on aquatic habitats and species.

Some benthic habitat and benthic organisms would be lost when the area inside the cofferdam is dewatered and as the area is dredged. An excavator operating from the riverbank would perform the dredging to minimize in-water impacts (Duke 2009c). Dredged material would be placed in an onsite spoils area (Duke 2013d). The area near the intake structure had low macroinvertebrate bioclassification scores (Fair and Poor), indicating that existing habitat conditions are already deficient for macroinvertebrates at this location (Derwort and McCorkle 2006). Because the 0.54-ac area directly affected is small relative to the habitat available to benthic organisms in the region and the habitat quality is not exceptional, noticeable differences in the benthic community as a result of Broad River intake structure building activities are not expected. Also, after the cofferdam is removed, benthic organisms would be expected to recolonize the area.

Some riparian vegetation would be removed along the shore to accommodate building the intake (Duke 2009c). Removal of riparian vegetation from shorelines can destabilize the riverbank or contribute to water warming because some areas are no longer shaded by vegetation. Hazardous-chemical spills associated with machinery and other installation activities could be injurious to fish and other aquatic organisms. To minimize potential impacts from these activities, all work would be performed in compliance with the conditions of applicable authorizations from the USACE (§404 wetlands), Cherokee County floodplain administration, and the SCDHEC (§401 certification and NPDES program) (Duke 2008f). Duke also would implement BMPs to limit erosion along the bank (Duke 2009c). Perimeter controls, such as vegetated buffer strips, would be used in combination with other techniques, such as silt fences and fiber rolls, where the work site meets the Broad River to minimize the possibility of excess sediments reaching the river (Duke 2009c). A SWPPP and Erosion Control Plan would be in place to limit and mitigate potential impacts on surface waters from stormwater runoff, bank erosion that could occur while the disturbance area is unvegetated, and sedimentation and temporary degradation of surface waters and/or wetlands associated with in-water installation activities (Duke 2009c). These plans would include the use of temporary discrete discharge locations that would be pretreated and equipped with an oil recovery boom to reduce suspended sediment loads and handle an unanticipated release of oil or grease to the aquatic environment (Duke 2009c).

After installation of the intake structure, native vegetation would be allowed to re-establish itself in all areas except along the length of the screen house where the growth of vegetation would be prevented (Duke 2009c). This absence of vegetation may result in a slight decrease in shading along that portion of the west bank, but slope protection would be built around the intake structure to permanently stabilize the slope. Most of the slope protection around the intake structure would be completed prior to removal of the cofferdam (Duke 2009c).

Blowdown and Wastewater Discharge Structure

Installation of the blowdown and wastewater structure would require dewatering activities behind a temporary cofferdam extending 100 ft from the shoreline. This activity would result in the temporary draining of 0.15 ac of open water behind the cofferdam and the temporary placement of fill over 0.04 ac of substrate within the Ninety-Nine Islands Reservoir (Duke 2011f, h; 2012n). Dredging would permanently impact 1 ac of substrate and would be performed in two locations: near the shoreline inside the cofferdam to install the discharge pipe at the correct elevation and in the Ninety-Nine Islands forebay to maximize mixing volume at the forebay (Duke 2011h, 2012n). A 3-ft-inside-diameter, high-density polyethylene pipe would run from the shore out into the Broad River along the upstream side of Ninety-Nine Islands Dam. The top of the pipe would be installed 10 ft below the full-pond elevation of the Ninety-Nine Islands Reservoir (Duke 2011h). The work is expected to take approximately 3 months and would be scheduled for completion during the late summer to fall when water levels are typically low (Duke 2008f). This time frame should also minimize disruption to spawning activities and fish migration (Duke 2009c). Increased noise and movement of workers, equipment, and materials should cause only temporary displacement of fish from the area (Duke 2009c). Minimal impacts on aquatic organisms from piping installation are anticipated because pipe sections would be assembled onshore, positioned using a barge, and attached to the face of the dam by divers. Temporary impacts on benthic macroinvertebrates or other aquatic species from increased turbidity are anticipated in association with dredging activities in the vicinity of the blowdown and wastewater diffuser. As discussed in Section 4.3.1, BMPs, an Erosion Control Plan, a SPCCP, and an SWPPP would be used to minimize the potential for the harmful release of sediments or other pollutants into the water (Duke 2009c). Duke also would be working in accordance with the CWA Section 401 State water-quality certification and the Department of the Army permit that define what activities would and would not be allowed to protect local and downstream habitats and organisms from harm.

Make-Up Pond A

Dredging, excavating, and construction activities would affect aquatic organisms in Make-Up Pond A. The existing cofferdams and soil outcrops in the central portion of Make-Up Pond A would be removed via dredging (3.26 ac). This would help to improve flow conditions in the vicinity of the proposed intake structure (Duke 2011, 2012n). The former Cherokee Nuclear Station intake structure in Make-Up Pond A would be partially removed, but a portion would be left in place to provide access to the proposed new Make-Up Pond A intake structure located further offshore (Duke 2012h). A temporary cofferdam (to be removed upon completion of building the intake) would be placed around the site of the proposed intake structure to allow dewatering 1.08 ac of the work area, followed by excavation and building activities. Cofferdam placement would result in the temporary loss of 0.20 ac of benthic habitat. Installation of the new intake structure would result in the permanent loss of 0.22 ac of substrate in Make-Up Pond A, whereas dredging associated with building the new intake would permanently disturb 1.06 ac of substrate (Duke 2012n). In addition, a discharge structure that would receive water from the Broad River (normal operations) or from Make-Up Pond B (low-flow operations) would be installed near the northwest corner of Make-Up Pond A (Figure 3-4, grid reference C2) and would result in the permanent loss of 0.07 ac of substrate and the temporary draining of 0.48 ac of open water (Duke 2010f, 2012n).

Duke would be regulated by any restrictions imposed by the USACE under the Department of the Army permit. Duke also has indicated it would use BMPs and conform to the standards of the SWPPP that would be developed as part of the NPDES permitting process (Duke 2009c).

Dredging and excavating portions of Make-Up Pond A would temporarily displace fish, remove benthic organisms, and create conditions of higher than normal turbidity for the pond residents. The benthic community is expected to become gradually reestablished, but because operation of a new nuclear power station would result in water input from the Broad River to the pond, turbidity would be at a level greater than current conditions, and there could be a shift in species diversity and abundance (Duke 2009c). Disposal of dredged or excavated material removed from Make-Up Ponds A and B would be in an onsite spoils area (Duke 2013d).

Some drawdown of water level in Make-Up Pond A would be required during installation of the Make-Up Pond A intake and discharge structures to relieve pressure on the cofferdams. Duke expects the water level would be drawn down 20 ft for approximately 32 months. The proposed drawdown would temporarily reduce the water surface area of Make-Up Pond A by approximately 28 ac (Duke 2012o). Benthic, littoral, and shoreline habitats would be temporarily altered. Water temperatures within Make-Up Pond A are likely to increase and dissolved oxygen levels are likely to decrease. Duke maintains that sufficient volume to provide fish refuge would remain (Duke 2011h). The sunfish species present in Make-Up Pond A are resilient and would likely adapt to the altered conditions; however, the benthic community would be lost in the dewatered littoral zone. After water levels are restored, benthic organisms would be expected to recolonize the area.

Impacts associated with cofferdam placement and dewatering in Make-Up Pond A would be less than those described for the river intake structure because there would be no river flow restriction. Leakage through the sheet-pile cofferdams would be pumped through a sock filter and then discharged back into the pond. A turbidity screen placed in the pond would also be used to minimize turbidity levels (Duke 2011). Fish trapped behind the sheet piling should be relocated to the unaffected portion of the pond or to the Broad River prior to dewatering. Except for a small proportion of fish that could be lost due to handling stress, the removal of fish is expected to produce only minor, temporary impacts. Other fish could be adversely affected when sediments are suspended during the installation and removal of the sheet pilings.

Fish currently inhabiting Make-Up Pond A are primarily sunfish species (centrarchids), none of which is considered rare or of special concern in the region (Table 2-12). Fishing is not allowed in the pond, so fish losses would not affect recreational fishing. The temporary disruption, or even loss, of the fish in Make-Up Pond A would not noticeably alter or destabilize the regional fish populations.

Make-Up Pond B

Installing the Make-Up Pond B combined intake/refill structure and its access causeway would involve dredging or excavation, installation of a temporary cofferdam dewatering, and placement of piping and concrete (Duke 2009b, c; 2010l, m, p). Placement of fill for building the new intake/refill structure would result in the permanent loss of 1.07 ac of substrate, whereas dredging would permanently disturb 2.09 ac of substrate (Duke 2012n). In addition, as described in Section 3.2.2.2, a discharge structure that would receive water from the Broad River (during refill operations) or from Make-Up Pond C (during low-flow operations) would be located along the shoreline west of the Make-Up Pond B spillway (Figure 3-4, grid reference B2) and result in the permanent loss of 0.06 ac of substrate (Duke 2009c, 2012n). Temporary cofferdams (to be removed upon completion of building activities) would be placed around the sites of the proposed intake/refill and discharge structures to allow dewatering of each area, followed by excavation and building activities. Placement of the cofferdams would result in the temporary loss of 0.51 ac of benthic habitat (0.43 ac at the intake/refill structure and 0.08 ac at the discharge structure) and the temporary draining of 0.22 ac of open water (0.09 at the intake/refill structure and 0.13 ac at the discharge structure) (Duke 2011h, Duke 2012n).

Drawdown of the pond water level would also be required during installation of the intake/refill and discharge structures to relieve pressure on the cofferdams. Duke expects the water level would be drawn down 20 ft for approximately 34 months. The proposed drawdown would temporarily reduce the surface area of Make-Up Pond B by approximately 64 ac (Duke 2012o). Benthic, littoral, and shoreline habitats would be temporarily altered. Water temperatures would likely increase and dissolved oxygen levels would likely decrease. Duke maintains that sufficient volume to provide fish refuge would remain (Duke 2011h). The fish species present in Make-Up Pond B, primarily sunfish, Carp (*Cyprinus carpio*), catfish, and Gizzard Shad (*Dorosoma cepedianum*) are resilient and would likely adapt to the altered conditions; however, the benthic community would be lost in the dewatered littoral zone. After water levels are restored, benthic organisms would be expected to recolonize the area.

Duke would be required to comply with the requirements of the individual Department of the Army permit issued by the USACE. Duke also has indicated it would use BMPs and conform to the standards of the SWPPP that would be developed as part of the NPDES permitting process (Duke 2009c).

Common fish species in Make-Up Pond B include sunfish, gizzard shad, carp (cyprinids), and catfish (ictalurids) (Duke 2009c). None of these species is considered rare or of special concern in the region. Fishing would not be allowed in the pond, so fish losses will not affect recreational fishing. Fish trapped behind the sheet piling should be relocated to the unaffected portion of the pond or to the Broad River before dewatering. Except for a small proportion of fish that could be lost because of handling stress, fish removal from behind the sheet piling or from the pond to the river is expected to cause only minor, temporary impacts on those fish. Fish could be affected adversely when sediments are suspended during the installation and removal of the sheet pilings and during startup of the intake system. Overall, the temporary disruption, or even loss, of the fish in Make-Up Pond B would not noticeably alter or destabilize the regional fish populations.

Hold-Up Pond A

Because no modifications are planned for Hold-Up Pond A, the primary impact of site-preparation activities on Hold-Up Pond A aquatic biota is expected to come from stormwater runoff. Some stormwater flows would be directed to this pond during site preparation (Duke 2009c). This could temporarily increase turbidity levels within the pond and temporarily affect fish. Only Largemouth Bass (*Micropterus salmoides*), Bluegill (*Lepomis macrochirus*), Redbreast Sunfish (*L. auritus*), and sunfish hybrids (centrarchids) were captured in this pond. None of these species is considered rare or of special concern in the region. Fishing would not be allowed in the pond, so fish losses would not affect recreational fishing. Because Duke has indicated it would use BMPs and conform to the standards of the SWPPP that would be developed as part of the NPDES permitting process, impacts on aquatic biota are expected to be minimal (Duke 2009c).

Make-Up Pond C

Impacts on aquatic resources in London Creek and its unnamed tributaries are identified below:

- *Improvement of temporary logging roads*. Vegetative clearing, grading, roadside ditch excavation, and crushed stone placement could result in increased stream temperatures and turbidity. Roads required for the construction of Make-Up Pond C would result in the permanent placement of culverts and fill material within 223 linear ft of stream substrate. These roads would ultimately be inundated by the Make-Up Pond C and a new aquatic substrate would form (Duke 2012n).
- Removal of vegetation from within the Make-Up Pond C footprint and 50-ft buffer area (i.e., a 50-ft wide area around the full-pond elevation of Make-Up Pond C). Clearing, grubbing outside the footprint (884 linear ft of stream shoreline vegetation within the 50-ft buffer), and grading could result in sediment movement into London Creek and its unnamed tributaries or compaction of sediments in or near stream beds (Duke 2012n). Operation of heavy equipment could result in leaks or spills of petroleum products into the aquatic environment. Because of the reduction in shading from riparian vegetation, water temperatures could increase, leading to decreases in dissolved oxygen concentrations. Removal of vegetation also would result in decreased input of woody debris and leaf litter to London Creek and its tributaries. Woody debris and leaf litter provide habitat structure and food resources for aquatic biota.
- *Installation of the dam and associated structures*. The diversion of London Creek around the work area during installation of the dam and other permanent structures (i.e., water-control structure, toe drain, emergency spillway, spilling basin, riprap, saddle-dike structures, reservoir outfall, pump/intake structure, break tank, buildings, and other structural foundations) is expected to take approximately 2 years (Duke 2010f). The installations would result in dewatering of the work area and permanent loss of some benthic macroinvertebrates, stream habitat, and possibly fish. Fill material associated with building the Make-Up Pond C infrastructure would fill 2663 linear ft of stream substrate, excavation for borrow material would eliminate 267 linear ft of stream substrate, and disposal of spoil material would affect 730 linear ft stream substrate (Duke 2012n). To the extent possible, Duke expects they would avoid known spawning seasons for installation of cofferdams (Duke 2010f). While building of Make-Up Pond C is under way, the London Creek flow would be allowed to pass through sediment settling structures and pipes to downstream of the Make-Up Pond C dam. During the transition period between construction and pond filling, when the pipes would be sealed, pumps would be used (Duke 2012n). While the stream is diverted around the work area, up to seven submersible pumps would be used to pass flows as great as a 25-year, 24-hour storm. Under normal conditions flow would be passed with a single pump, throttled to match incoming flow as closely as possible, so that there would be very little change to downstream flow (Duke 2010c). Pumping for temporary stream diversion would be in accordance with the Department of the Army permit conditions

(Duke 2010c). The pump inlet would be screened with 0.25-in^2 welded wire fabric, which would prevent entrainment of juvenile and adult fish but would not prevent entrainment of fish eggs or larvae. Thus, some small fish could be diverted to the downstream side of the dam during pumping operations, but there would be no effort to capture fish upstream and relocate them downstream (Duke 2009b). A single intake/discharge structure would be built at Make-Up Pond C to receive water from the Broad River and to pump water between Make-Up Ponds B and C (Duke 2009b). The intake/discharge structure includes an access bridge and pump platform (Duke 2011h). Installation would be completed before the pond is filled with water, thus minimizing the potential for aquatic impacts.

- *Filling of the reservoir (proposed Make-Up Pond C)*. Filling the reservoir would result in the permanent loss of lotic (flowing water) habitat within the reservoir footprint. The impoundment of Make-Up C would convert 60,414 linear ft of streams and 0.03 ac of open-water habitat to deep open water (Duke 2012n). With the possible exception of a segment approximately 0.6 mi in length between the Make-Up Pond C dam and the junction with the Broad River (Section 9.5.3.1), the main stem of London Creek would be inundated and the resulting Make-Up Pond C impoundment would replace a lotic system with a lentic system. Some aquatic functions would remain, in particular, flood attenuation and water quality, and some aquatic species (e.g., sunfish) could adapt to the lentic environment. In addition, some of the upper reaches of tributaries to London Creek not impounded would retain their lotic characteristics, but they would become isolated from other lotic habitat.
- *Realignment of SC 329 roadway and construction of a new bridge over the reservoir*. These activities include the placement of three culvert crossings to facilitate water flow from drainage areas (Duke 2011h). Culvert construction would affect 396 linear ft of streams (Duke 2012n). All of these activities would take place before the London Creek channel is inundated. During the building activities, cofferdams and diversions would route existing London Creek flow around the excavation area. Temporary activities such as clearing, grading, and paving have the potential to increase stream water temperatures and introduce sediment to London Creek. Upon completion of the bridge and realigned highway, the former London Creek channel would be inundated by an arm of Make-Up Pond C.
- *Lake Cherokee Dam and Spillway*. The placement of riprap to stabilize the embankment of the Lake Cherokee Dam would permanently affect 218 linear ft of stream substrate and 0.02 ac of open water. The riprapped embankment would ultimately be inundated by Make-Up Pond C (Duke 2012n).
- *Rerouting of a 44-kV transmission-line right-of-way*. The proposed clearing and inundation of the London Creek drainage to form Make-Up Pond C would require removal of an approximately 2-mi-long portion of an existing out-of-service 44-kV transmission line. The new transmission ROW would be rerouted to skirt the west side of the pond (Figure 3-1) (Duke 2011h). The 100-ft-wide easement would cross several unnamed tributaries (estimated 229 linear ft) and impoundments (Duke 2010n). The use of BMPs for erosion

and sediment control in compliance with SCDHEC regulations during removal activities would minimize any adverse impacts on aquatic resources (Duke 2009b). A new transmission line is not currently needed and would not be installed in the new ROW until a need is identified (Duke 2011h).

At the request of the SCDNR and the SCDHEC, Duke has proposed a minimum flow regime below the Make-Up Pond C dam that would commence with the filling of the reservoir and be protective of aquatic resources downstream of the dam to the confluence of London Creek with the Broad River (Duke 2012m). While the pond fills, expected to take approximately 110 days (Duke 2011h), minimum flow would be achieved by pump(s) (Duke 2012n). Once the reservoir reached full pool elevation, Duke would release any continuous minimum flow to London Creek via the Make-Up Pond C spillway structure, approximately 500 ft downstream from the toe of the Make-Up Pond C dam (Duke 2012m). Based on historical flow data collected at London Creek, Duke has proposed the following minimum seasonal flow releases: January through April 1.5 cfs; May, June and December 1.0 cfs; July through November 0.75 cfs (Duke 2012m). A mitigation action plan, including compensatory mitigation incorporating restoration and preservation, for permanently or temporarily affected waters of the United States (e.g., wetlands and streams) within the jurisdiction of the USACE would be developed and implemented by Duke according to conditions to be set forth in an individual Department of the Army permit issued by the USACE and the associated CWA Section 401 water-quality certification issued by the SCDHEC (Duke 2010n). Duke has discussed an approach to compensatory mitigation with the USACE; it is described in Section 4.3.1.7. Site-specific BMPs also would be stipulated by the Department of the Army permit.

Farm Ponds

Dams of farm ponds in the vicinity of proposed Make-Up Pond C would be breached to eliminate dam safety issues (Duke 2011h). Draining the farm ponds would result in impacts on 17.53 ac of open-water habitat (Duke 2012n). Some of the drained open-water areas would be used as spoil stockpiling areas and one small pond (0.03 ac) would be inundated by the impoundment (Duke 2011h). Duke would discuss the disposition of fish and turtles present within the ponds with the SCDNR before dewatering takes place (Duke 2010d).

Railroad Spur

Within the railroad-corridor component of the jurisdictional determination prepared by the USACE (2013a), there are 21 stream crossings and 5942.14 linear ft of streams. Building impacts within the railroad-corridor permit area component include permanent impacts on 145 linear ft of London Creek and temporary impacts on 1345 linear ft of tributaries. Permanent impacts result from culvert replacement, whereas temporary impacts may result from installation of temporary cofferdams (25 linear ft) and the potential for associated backwater flooding (1320 linear ft) during a 10-year storm event. There are no impacts on open waters (Duke

2011h, 2012n). Two 120-in.-diameter steel-pipe culverts under the existing railroad spur would be replaced with a four-cell 12- × 10-ft reinforced concrete box culvert that would expand the hydraulic capacity of the London Creek crossing, reduce erosive velocities downstream, and provide a stable crossing for trains (Duke 2009b, 2010f, 2011h). The invert elevation of one cell would be modified to serve as the primary flow path under ordinary flow conditions. The bottom of the primary flow path cell would be modified into a roughened channel with engineered streambed material to create a more natural channel flow for the passage of fish and other aquatic organisms (Duke 2012j). The effort is expected to take approximately 13 months from start to finish (Duke 2010f). This activity would require diversion of London Creek around the work area while the culvert is replaced. This would result in temporary dewatering of the work area and loss of some benthic macroinvertebrates, fish, and larval salamanders. To minimize potential disturbance and sediment loading to streams, the work would be completed using large cranes and excavators from the top of the railroad embankment (Duke 2011h). Excavated materials would be placed atop the railroad-spur embankment to avoid placement in sensitive areas (Duke 2009b). The Department of the Army permit would be required before earth moving commenced, and the permit process would address the need for any compensatory mitigation. Duke would also submit a SWPPP to the SCDHEC that describes the erosion and sediment-control methods that would be employed during soil disturbance activities. These methods would be in accordance with the SCDHEC Stormwater Management BMP Handbook (2005), the *Duke Energy BMP for Stormwater Management and Erosion Control Policy and Procedures Manual*, and SCDOT BMPs (Duke 2009b, 2011h). After installation of the new culvert, Duke would restore the stream channel (Duke 2009b). Because the new box culvert would result in improved streamflow and because the cofferdams and the potential backwater flooding events would be temporary, the adverse impacts on aquatic resources are expected to be minimal.

4.3.2.2 Aquatic Resources – Transmission Lines

Duke has sited the new 230-kV and 525-kV transmission lines in accordance with SC Code Annotated § 58-33-110. Duke procedures for implementing this code included consultation with the FWS and an evaluation of impacts on special habitats and threatened and endangered species. In addition, Duke would comply with all applicable laws, regulations, and permit requirements and would use good engineering and building practices (Duke 2008b; HDR/DTA 2009b).

Within the proposed 31 miles of new transmission-line corridors, there are 14,596 linear ft of streams within the western corridor (Route K) and 25,530 linear ft of streams and a 4.06-ac open water impoundment within the eastern corridor (Route O) (USACE 2013a). Transmission-line structures would be located within upland areas and streams and open water would be spanned by the transmission lines. No direct impacts on streams or open waters would occur (Duke 2011h). The transmission lines would be installed in accordance with Duke Energy

Stormwater BMP manuals and SCDHEC BMPs (Duke 2011h). BMPs for transmission-line corridor and structure installations consist of considerations for site preparation, sediment traps and barriers, access road placement, stream crossings, runoff-control measures, structure placements, and surface-stabilization measures. A naturally vegetated buffer zone, with a minimum width of 25 ft, would be maintained on each side of the stream or open water. Currently, most of the streams within the proposed transmission-line corridors have forested riparian buffers (Duke 2011h). Vegetation maintenance within these buffer zones would be performed by hand-clearing (i.e., chain saws) and limited to that necessary to provide adequate conductor clearances (i.e., removal of canopy trees). Understory trees and shrubs would be retained, to the extent practicable, to provide erosion control and some shade to aquatic habitat (Duke 2011h). Minimal indirect impacts (i.e., potential for increased sedimentation and reduced shading) are expected on the 46 stream crossings identified in the western corridor (Route K) and the 70 stream crossings and 4.06-ac open-water impoundment identified in the eastern corridor (Route O) (Duke 2011h). The watercourses identified within both corridors range from small, first-order headwater tributaries to the Pacolet River (HDR/DTA 2009b; Duke 2011h). Surveys for threatened and endangered species were conducted by Duke in the delineated corridor between March and May 2009, based on inventory lists for Federally and State-protected species in Cherokee, Union, and the adjacent York and Chester Counties (HDR/DTA 2009b; Duke 2008b). The Carolina heelsplitter (*Lasmigona decorata*) was the only protected aquatic species potentially found in that area. It is listed as endangered by both the FWS and the State of South Carolina and is also State-ranked as S1 (critically imperiled). The survey found no occurrence of the Carolina heelsplitter, known to occur in the Catawba River drainage, and the FWS concurred in a letter to Duke dated August 26, 2009, that construction of the new 230-kV and 525-kV transmission lines would have no effect upon Federally listed species (HDR/DTA 2009b; Duke 2008b).

4.3.2.3 Important Aquatic Species

This section describes the potential impacts on important aquatic species, including Federally and State threatened or endangered species, State-ranked species, and ecologically important species, resulting from building the proposed new nuclear units at the Lee Nuclear Station site, the new transmission-line corridors, the Make-Up Pond C reservoir, and the new expanded culvert under the railroad spur.

Federally Listed Species

As previously discussed in Section 2.4.2.3, Important Aquatic Species, the FWS indicated that one listed mussel species, the Carolina heelsplitter, was known to be present in York County, which bounds the Broad River downstream of Ninety-Nine Islands Dam (Table 2-13). However, the review team reviewed the literature and species summaries and found no evidence there are likely to be any Federally listed aquatic species in the vicinity of the Lee Nuclear Station site (FWS 2010d).

The Carolina heelsplitter, an endangered mussel species, has not been located in the Broad River or its tributaries, but does occur within the Catawba River drainage (SCDNR 2005). Critical habitat has been designated only in Chesterfield, Edgefield, Greenwood, Kershaw, Lancaster, and McCormick Counties in South Carolina, none of which are associated with the proposed Lee Nuclear Station construction or preconstruction activities (67 FR 44501). In a letter dated June 13, 2012, the FWS concurred with the review team's determination that the proposed Lee Nuclear Station Units 1 and 2 project is not likely to adversely affect Federally protected species nor result in adverse modification of designated or proposed critical habitat, thus completing informal consultation between the FWS and NRC (FWS 2012b). No further action under Section 7 of the Endangered Species Act is required. Consultation correspondence between the review team and the FWS is included in Appendix F.

State-Ranked Species

<u>Carolina Fantail Darter (*Etheostoma brevispinum*)</u>

The Carolina Fantail Darter is State-ranked S1 (critically imperiled) (SCDNR 2012a) and is classified by the SCDNR as a species of high priority on its Priority Conservation Species List (SCDNR 2005). This darter has been captured previously in limited numbers in the vicinity of the proposed Broad River intake structure (Duke 2009c) and discharge structure (Duke 2008a). Therefore, it is possible this fish species could be affected by installation activities associated with the Broad River intake and discharge structures, although the preferred habitat of the Carolina fantail darter is gravel riffles where stronger currents exist (SCDNR 2005). The primary impact to the Carolina fantail darter would likely be temporary displacement from the work zones while each area is dewatered (Duke 2009c). Because the areas that would be disturbed by installation activities are not the preferred habitat of the Carolina fantail darter and Duke would employ BMPs in accordance with conditions specified in its CWA Section 401 State water-quality certification, Department of the Army permit, Erosion Control Plan, SPCCP, and SWPPP, the potential for a sediment or other pollutant release to occur and harm the Carolina Fantail Darter in the Broad River is minimal (Duke 2009c).

Additional Species of Ecological Importance

A number of aquatic species are listed by the State of South Carolina as highest or high priority conservation species. This is not a State listing *per se*, but does indicate that the species or their habitat may be in some jeopardy in South Carolina and/or in other states (SCDNR 2005). Five fish species, each listed as highest or high priority conservation species by the SCDNR, were found during surveys conducted by Duke or the SCDNR in the Broad River in the vicinity of the proposed new nuclear station, in London Creek, or in tributaries to the Broad River that may be crossed by new transmission-line corridors associated with the proposed new nuclear station. The five species are (1) Highfin Carpsucker (*Carpiodes velifer*), (2) Quillback (*C. cyprinus*), (3) Seagreen Darter (*Etheostoma thalassinum*), (4) Greenhead Shiner (*Notropis* *chlorocephalus*), and (5) Piedmont Darter (*Percina crassa*). These species may be affected negatively by deterioration in water quality because of sedimentation or habitat degradation from deforestation or loss of riparian cover. The use of BMPs to reduce siltation would minimize impacts from sedimentation. Restoration of riparian vegetation also would keep impacts to a minimum. Duke intends to restore river or creekside habitat after completion of building activities and would adhere to the best practices outlined in the *Duke Energy BMPs for Stormwater Management and Erosion Control Policy and Procedures Manual* (Duke Energy 1999).

The Highfin Carpsucker is given highest conservation status in South Carolina (SCDNR 2005). It may have been captured by the SCDNR in 2002 just below Cherokee Falls Dam and below Ninety-Nine Islands Dam (Bettinger et al. 2003). The Quillback is given high conservation priority (SCDNR 2005). It was captured by the SCDNR in 2001 and 2002 at eight sites on the Broad River, including sites in the vicinity of the Lee Nuclear Station site (Bettinger et al. 2003). A single specimen was captured by Duke while electrofishing in the backwater areas in 2006. Quillback were also captured in 2006 by using gillnetting techniques in the Ninety-Nine Islands Reservoir (Duke 2009c, Barwick et al. 2006) and electrofishing downstream of Cherokee Falls (Barwick et al. 2006). The Seagreen Darter also has high conservation status (SCDNR 2005). It was found by the SCDNR in 2003 and 2004 in Thicketty Creek, a tributary to the Broad River that would be crossed by new transmission-line corridors associated with the Lee Nuclear Station (Bettinger et al. 2006). The Greenhead Shiner has a high conservation status and was captured in 2010 by the SCDNR in London Creek (SCDNR 2011b). The Piedmont Darter has high conservation status as well (SCDNR 2005). This darter species was captured by the SCDNR in 2000, 2001, and 2002 at 10 sites on the Broad River, including sites in the vicinity of the proposed new nuclear station (Bettinger et al. 2003). The Piedmont Darter also was captured by Duke in 2006, but only below Ninety-Nine Islands Dam (Duke 2009c).

Recreational Species

The Broad River, and therefore Ninety-Nine Islands Reservoir, support recreational fisheries for various species of sunfish, crappie, bass (centrarchids); catfish (ictalurids); and suckers (catostomids). Except for catfish, these species have life histories that indicate known use of shallow-water habitats for reproduction and nesting activities. The use of turbidity curtains and cofferdams can minimize impacts on these shallow-water habitats. However, the timing of installation activities may have more detrimental effects on aquatic resources if performed during critical spawning seasons in mid-to-late spring. Duke has stated that, to the extent practicable, they will schedule the installation and removal of cofferdams to avoid spawning seasons, and minimize the extent and magnitude of impacts on aquatic habitats (Duke 2008f).

Aquatic Monitoring during Site Preparation

Duke has not specified any formal site-preparation-related monitoring (Duke 2009c). It bases this decision on the fact that dredging and other site-preparation activities would be permitted by the USACE and other Federal and State regulators, who are likely to specify pre-disturbance-related monitoring as part of the permitting process. Duke has committed to implementing BMPs during site-preparation and development activities and will have an SWPPP and a SPCCP approved in association with its required SCDHEC NPDES stormwater permit.

Duke states it would "… comply with all applicable laws, regulations (including regulatory requirements of the SCDHEC, the South Carolina State Historic Preservation Office, etc.), permit requirements, and good engineering and building practices during installation of the transmission-line corridors" (Duke 2009c).

4.3.2.4 Summary of Impacts on Aquatic Ecosystems

The review team has reviewed the proposed site construction and preconstruction activities associated with Lee Nuclear Station Units 1 and 2 and the potential impacts on aquatic biota in the Broad River and Ninety-Nine Islands Reservoir, onsite ponds and streams, London Creek and its unnamed tributaries, and other offsite waterbodies associated with transmission-line corridors.

The proposed preconstruction and construction activities at the Lee Nuclear Station site, Make-Up Pond C area, and railroad-spur corridor would affect 29.63 ac of open water and 67,285 linear ft of streams (Table 9-19) (Duke 2012n). In addition, there are planned 20-ft drawdowns of Make-Up Ponds A and B, for approximately 32 and 34 months, respectively, to relieve pressure on the cofferdams required for the installation of the intake (Make-Up Pond A), intake/refill (Make-Up Pond B), and discharge (both Make-Up Ponds A and B) structures. These drawdowns would temporarily reduce open-water habitat within Make-Up Pond A by approximately 28 ac and within Make-Up Pond B by approximately 64 ac (Duke 2012o). Impacts on aquatic resources would be mostly controlled by the use of BMPs associated with the management of water quality. The SCDNR has concurred with the proposed work plan for drawdown of Make-Up Ponds A and B (SCDNR 2012m). By following BMPs associated with water quality (developed by Duke and accepted or modified by State and Federal agencies through the permitting process), the impacts of installation of water intake and discharge structures at the Lee Nuclear Station site on aquatic biota would be short term but noticeable. Similarly, the use of BMPs during replacement of a culvert under the existing railroad spur would minimize negative impacts on aquatic resources. There are no impacts on streams or open waters associated with the installation of the offsite transmission lines (Duke 2012n).

Prior to inundation of London Creek and its tributaries, impacts on streams and open waters would occur due to excavation of borrow material, placement of fill and spoil material, building of new haul roads, and temporary flooding associated with the use of cofferdams (Duke 2011h). Impounding London Creek and building the Make-Up Pond C supplemental water reservoir would replace a lotic system with a lentic system, resulting in a clearly noticeable and permanent change in aquatic resources in London Creek and its tributaries. Some of the upper reaches of tributaries to London Creek not impounded would retain their lotic characteristics, but they would become isolated from other lotic habitat. Most of the riparian habitat of the main-stem London Creek would be lost, with the possible exception of a segment approximately 0.6 mi in length between the Make-Up Pond C dam and the confluence with the Broad River. Some aquatic functions would remain, in particular, flood attenuation and water quality, and some aquatic species (e.g., sunfish) could adapt to the lentic environment. Although the aquatic resources found in London Creek are not unique to the region, the habitat type is becoming increasingly rare as development in the region increases. In time, the lacustrine aquatic habitat of the new reservoir would be valuable for other reasons, but it does not mitigate the loss of riparian habitat within a Piedmont watershed.

Based on information provided by Duke and the review team's independent evaluation, the review team concludes that the impacts on aquatic resources from the combined construction and preconstruction activities for the proposed Lee Nuclear Station Units 1 and 2 would be MODERATE, primarily because of the loss of a major portion of London Creek and its aquatic biota. In consultation with the USACE, Duke is designing compensatory mitigation appropriate to offset impacts on wetlands, streams, and other waters of the United States within the jurisdiction of the CWA.

All of the impacts on aquatic resources would be from preconstruction activities, such as clearing and grading forested land; installing drainage and erosion-control systems; building temporary roads and laydown yards; eliminating streams and ponds; adding impervious surfaces to the watersheds; and installing cofferdams, dewatering, and excavating. Therefore, the NRC staff concludes that the impacts on aquatic biota and habitats from NRC-authorized construction activities would be SMALL, and no further mitigation specific to NRC-authorized construction would be warranted.

4.4 Socioeconomic Impacts

Socioeconomic impacts occur in the region surrounding the proposed site. This discussion emphasizes socioeconomic impacts from building activities on the two-county area of Cherokee and York Counties, although it considers the entire 50-mi region surrounding the Lee Nuclear Station site.[a] The scope of the review is guided by the magnitude and nature of the expected impacts of the proposed project activities and by the site-specific community characteristics that can be expected to be affected by these activities.

(a) For the purposes of this EIS, the relevant region is limited to the area necessary to include social and economic base data for (1) the county in which the proposed plant would be located and (2) the specific portions of surrounding counties and urbanized areas (generally, up to 50 mi from the Lee Nuclear Station site) from which the construction and/or operations workforce would be principally drawn, or that would receive stresses to community services by a change in the residence of building and/or operations workers.

Large projects, such as the proposed Lee Nuclear Station, can affect individual communities, the surrounding region, and minority and low-income populations. This evaluation assesses the impacts of project-related activities and of the onsite workforce during the Lee Nuclear Station building activities on the communities and governmental jurisdictions within 50 mi of the site. Unless otherwise specified, the primary sources of information for this section are the ER (Duke 2009c) and the Make-Up Pond C supplement to the ER (Duke 2009b). The review team's conclusions are based upon independent verification of the information in the ER; visits to the site, vicinity, and region; and consultation with local officials.

The Lee Nuclear Station site first saw activity in the late 1970s and early 1980s for the unfinished Cherokee Nuclear Station. The review team found little data on the socioeconomic impacts for the first round of project activities. Therefore, this EIS will not make a comparison of building activities between the previous and the proposed projects.

Parts of the surrounding region have experienced significant growth over recent decades; as a result, the area has adjusted to providing services needed by in-migrating populations. The region has not been insulated from recent negative economic impacts from the current economic downturn. Although the review team considered the entire region within a 50-mi radius of the Lee Nuclear Station site when assessing socioeconomic impacts, the primary region of interest for physical impacts is the area within a 10-mi radius. The region of interest with regard to social and economic impacts encompasses the entire 50-mi radius but includes primarily Cherokee and York Counties in South Carolina. Based on commuter patterns, discussions with local community leaders, and the distribution of residential communities in the area, the NRC review team found *de minimis* impacts on other counties within the 50-mi radius in South Carolina and North Carolina. Although the review team recognizes some construction workers may live outside Cherokee and York Counties, their impacts would be dispersed over a wider, more populated area and therefore have been excluded from much of the socioeconomic analysis pertaining to building and operation of proposed Lee Nuclear Station Units 1 and 2.

The following sections describe the physical impacts on the site (Section 4.4.1), demographic impacts (Section 4.4.2), economic impacts on the community (Section 4.4.3), and the impacts on infrastructure and community services (Section 4.4.4). The impacts on minorities and low-income populations are covered in Section 4.5.

4.4.1 Physical Impacts

Building activities can cause temporary and localized physical impacts such as noise, odors, vehicle exhaust, and dust. Vibration and shock impacts are not expected because of the strict control of blasting and other shock-producing activities. This section addresses potential building impacts that may affect people, buildings, and roads.

4.4.1.1 Workers and the Local Public

The Lee Nuclear Station site and Make-Up Pond C site are located in an unincorporated area of Cherokee County without zoning laws and are bounded by the Broad River to the north and east and McKowns Mountain Road and private properties to the south and west. Two major industrial facilities are located within the vicinity of the Lee Nuclear Station site. The Broad River Energy Center is a natural-gas-fired, peaking electric generation plant located approximately 4.7 mi northwest of the site. Herbies Famous Fireworks is a 49 CFR 173.52, Division 1.4G (Class C) consumer fireworks wholesale distribution company located 2.7 mi north of the site. The recreational area closest to the plant is Kings Mountain State Park, which is located 7.8 mi northeast of the site and adjoined to Kings Mountain Military Park. These industrial and recreational areas could be affected by building proposed Lee Nuclear Station Units 1 and 2 because of increased traffic, noise, and dust from building activities (Duke 2009c).

Most building activities would occur within the Lee Nuclear Station site boundary, with the exception of building the railroad spur, expansion of the culvert along the railroad spur at London Creek crossing, transmission-line corridors, a new pipeline, rerouting of existing transmission lines, rerouting of SC 329 and adding a new bridge, and Make-Up Pond C (Duke 2009c). Work would be performed in compliance with Occupational Safety and Health Administration (OSHA) standards (Duke 2009c).

Noise

Noise is an environmental concern because it can cause adverse health effects, annoyance, and disruption of social interactions. Building activities are inherently noisy. Noise would result from clearing, earthmoving, foundation preparation, pile driving (if needed), concrete mixing and pouring, steel erection, and various stages of facility equipment fabrication, assembly, and installation, during which a substantial number of diesel- and gasoline-powered vehicles and other equipment would be used. Noise from the Lee Nuclear Station site and Make-Up Pond C site also would be generated from internal combustion engines, impact equipment, vehicles and other machinery and equipment. The noise impacts that project-related activities have on an area depends on sound intensity, frequency, duration, onsite location, the number of noise sources, time of day, weather conditions, wind direction, and time of year (Duke 2009c) as well as the locations of the receptors themselves. Duke projected noise levels from various equipment and found most building activities would have noise levels below background levels (50 to 55 dBA) and below the 60 to 65 dBA range of acceptable day-night, 24-hour average (Ldn) noise levels set by the U.S. Department of Housing and Urban Development. Building activities above an Ldn range of 60 to 65 dBA would be temporary. Visitors to the historic cemeteries and recreational areas on the Broad River may be affected by project noise. Terrain alterations during the building phase could change noise levels in these areas (Duke 2009c).

Other sources of noise are from transmission-line development and traffic-related noise. Transmission-line building activity noise is similar to building activities onsite except they have a shorter duration at each location along the corridor. Lee Nuclear Station workforce traffic and heavy equipment deliveries would increase noise along McKowns Mountain Road. Workforce-related traffic would be heaviest during shift change. At a speed of 55 mph, traffic-related noise at shift change would be approximately 75 dBA (Duke 2009c). Traffic-related noise impacts can be reduced by lowering the speed limit, shuttling workers, staggering shifts, and using the railroad spur for large deliveries.

Noise generated from building Make-Up Pond C would temporarily increase noise levels at nearby residences. There are residences within the acceptable range for noise levels of 65 dBA or greater. However, noise impacts to some of the nearby residences would be in part reduced due to intervening structures and terrain features (Duke 2009c).

All project activities would also be subject to regulations from the Noise Control Act of 1972, Federal regulations for noise from construction equipment (40 CFR Part 204), OSHA regulations (29 CFR 1910.95), and State regulations. The review team expects that noise impacts on recreation and the general public would be minimal with the use of the mitigation actions included in the above regulations (as applicable) and because noise attenuates rapidly with distance, intervening vegetation, and variations in topography. Consequently, the review team concludes that noise impacts on surrounding communities from these project building activities would be negligible.

Air Quality

Cherokee County is in the Greenville-Spartanburg Intrastate Air Quality Control Region (South Carolina). Cherokee County is classified as in attainment for all criteria pollutants, that is particulate matter, ozone, lead, oxides of nitrogen, carbon monoxide, and sulfur oxides. The baseline air-quality characteristics are described in Section 2.9.2 of this EIS. The nearest nonattainment area to the proposed site is in the Charlotte-Gastonia-Rock Hill metropolitan statistical area, which includes a portion of York County, which is designated a marginal nonattainment area under the 2008 primary and secondary eight-hour ozone standard. Cherokee County is designated as in attainment for National Ambient Air Quality Standards (NAAQS) criteria pollutants (40 CFR 81.341). As a result, a conformity analysis on direct and indirect emissions is not required (40 CFR 93). If building activities include the burning of debris, refuse, or residual building materials, a permit would need to be secured from the State of South Carolina, and Duke would need to contact local county officials to determine which local ordinances, if any, must be followed.

Temporary and minor effects on local ambient air quality could occur as a result of normal project activities at the Lee Nuclear Station site and the development of Make-Up Pond C. Fugitive dust and fine particulate matter smaller than 10 micrometers (PM_{10}) in size would be generated during earthmoving activities, material-handling activities, by wind erosion, and other activities at borrow areas, laydown areas, access roads, and transmission-line and pipeline corridors. Vehicles used to haul debris, equipment, and supplies as well as equipment used for cutting, clearing, and mulching at the Make-Up Pond C area would create pollutants. Mitigation measures (e.g., paving or stabilizing disturbed areas, water suppression, reduced material handling) would minimize such emissions. Odors could result from exhaust emissions; however, odors dissipate onsite and would have no discernible impact on the local air quality. All equipment would be serviced regularly, and all industrial activities would be conducted in accordance with Federal, State, and local emission requirements.

Specific mitigation measures to control fugitive dust would be identified in a dust-control plan, or a similar document, prepared prior to project activities in accordance with all applicable State and Federal permits and regulations. These mitigation measures could include, but are not limited to, the following:

- stabilizing access roads and spoils piles
- limiting speeds on unpaved access roads
- periodically watering unpaved access roads
- housekeeping (e.g., removing dirt spilled onto paved roads)
- covering haul trucks when loaded or unloaded
- minimizing material handling (e.g., drop heights, double handling)
- suspending grading and excavation activities during high winds and during periods of extreme air pollution
- phase grading to minimize the area of disturbed soils
- revegetating road medians and slopes
- phasing project activities to minimize daily emissions
- performing proper maintenance of heavy vehicles to maximize efficiency and minimize emissions.

Therefore, although emissions from project activities and equipment operation are unavoidable, the review team concludes that Duke’s mitigation efforts would limit impacts on air quality during project activities and the impacts would not warrant mitigation beyond the possible measures discussed for inclusion in the mitigation plans.

4.4.1.2 Buildings

Several structures present at the site when Duke published the ER in 2007 have since been removed, including partially constructed power unit buildings and several large and small buildings used in support of construction activities at the unfinished Cherokee Nuclear Station. Several other buildings, including a guardhouse, still exist onsite. All structures within the Make-Up Pond C footprint would be removed and properly disposed of. According to Duke, 86 housing units within the Make-Up Pond C site have been demolished (Duke 2012b). Other than Pond C structures, no other offsite buildings were affected. Except for the existing structures on the Lee Nuclear Station site, no other industrial, commercial, or recreational structures would be directly affected by the development of the new facility.

4.4.1.3 Transportation

Public roads and railways would be used to transport building materials and equipment. Building proposed Lee Nuclear Station Units 1 and 2 would have a minimal impact on interstate and state highways in the region. However, local roads such as McKowns Mountain Road would be heavily affected. Duke would build several new access roads within the site boundaries to provide access to the power block, cooling towers, and other areas. Several existing roads within the site would be widened to 24 ft (Duke 2008e). All workers would access the site via McKowns Mountain Road and truck deliveries would use a new access road to the east of the current site entrance off McKowns Mountain Road. Duke plans to upgrade a railroad spur that links the site with the main line with new ballast and track to support equipment delivery. This activity is expected to take place primarily outside the site boundary but within the existing ROW (Duke 2009c). A heavy-haul road from the end of the railroad spur to the project areas is planned. Building of this road is contained within the existing site boundary (Duke 2009c). The railroad culvert at London Creek would be replaced with a box culvert, requiring the installation of sheet-pile cofferdams on both sides of the existing railroad line with a system to pump water (Duke 2009b).

The inundation of Make-Up Pond C would require the realignment of SC 329 slightly east of its current location and the addition of a bridge over London Creek. Approximately 1.3 mi of SC 329 would be affected, beginning approximately 200 ft north of McKowns Mountain Road and continuing approximately 1000 ft north of the intersection with Smith Road. Smith Road would be extended slightly to connect with the realigned SC 329. However, while the new bridge is built and road realigned the existing segment of SC 329 would remain open. The current segment of SC 329 would be removed once the new segment is open to the public and before Make-Up Pond C is inundated.

The review team concludes that the physical impacts of transportation would be limited and would not warrant mitigation.

4.4.1.4 Aesthetics

The Lee Nuclear Station site is bounded by woods and water features. Project-related activities would be visible to those using the Broad River and Ninety-Nine Islands Reservoir. Proposed Lee Nuclear Station Units 1 and 2 would use short and compact mechanical draft cooling towers expected to have minimal effects on local viewsheds. The tallest structures onsite during the building phase are expected to be the meteorology tower and cranes. Both consist predominantly of iron framework, which carries a lower visual weight than the solid concrete reactor domes. The most visible structures onsite would be the shield buildings at 229.4 ft above ground level (Duke 2012f). The reactor domes would be most visible from local parks in Gaffney, South Carolina; Kings Mountain State Park; Croft State Park; and Crowders Mountain State Park (Duke 2012f). Visual effects are inversely proportional to distance. Because most of the parks in the region are located more than 25 mi from the site, the most visible components at the Lee Nuclear Station would occupy less than one-fifth of a degree of vision (about the same perspective as a 1-ft-tall object viewed from a distance of 100 yd). Developing Make-Up Pond C would involve clearing forested land, which could negatively affect travelers on SC 329 and residents in the vicinity of the Make-Up Pond C site. The review team expects the aesthetic impacts would be noticeable but not destabilizing.

4.4.1.5 Summary of Physical Impacts

The review team evaluated information provided by Duke, visited the site and its environs, and performed an independent review of the potential physical impacts of building activities on the local area and region of the proposed Lee Nuclear Station. The review team concludes that physical impacts of construction and preconstruction would be SMALL, with one exception: a MODERATE physical impact on aesthetics. However, mitigation beyond the strategies outlined by Duke in its ER would not be warranted because physical impacts on aesthetics would be temporary. Because most of the aesthetic impacts are associated with developing Make-Up Pond C, the NRC-authorized construction activities represent only a portion of the analyzed activities. Therefore, the NRC staff concludes that the physical impacts of NRC-authorized construction activities would be SMALL. The NRC staff also concludes that no mitigation measures would be warranted for the construction activities.

4.4.2 Demography

Socioeconomic impacts are the result of project expenditures, employment, and the in-migration of workers and their families that changes population and employment baselines by drawing new residents into an area and/or by preventing the departure of existing residents from an area. Growth in population and employment increase spending in the area, leading to increased demand for housing, education, and other facilities and services. The assessment of demographic impacts related to building proposed Lee Nuclear Station Units 1 and 2 are based on the consequences of the employment and in-migration of new workers.

All workers onsite during the project are included in the assessment of impacts of the NRC-authorized activities, whether they are “construction” or “operations” workers. Building of proposed Lee Nuclear Station Units 1 and 2 would be staggered by a year, for a total site project period of approximately 93 months. This schedule would allow for sustained peak employment as employees finishing Unit 1 would be transferred to Unit 2. Duke would gradually reduce employment as both units were completed. Chapter 5 includes a discussion of all operations workers, including those discussed here in the context of the building phase.

Based on information provided by Duke, the peak workforce related to building activities at proposed Lee Nuclear Station Units 1 and 2 occurs in month 27, with an estimated 4613 workers. The 4613 peak workforce includes 4510 workers related to Units 1 and 2 and 103 workers related to Make-Up Pond C. The review team estimates that the 4510 workers related to Units 1 and 2 would consist of approximately 4398 construction workers and 112 operations workers onsite for training purposes during the peak project period.[a] Table 4-4 shows the number of workers during peak employment.

Table 4-4. Number and Type of Worker During Peak Employment

Units 1 and 2 related workers	4510
Construction workers	4398
Operations workers	112
Make-Up Pond C construction workers	103
Total construction workers	4501
Total operations workers	112
Total workforce	4613

As discussed in Section 2.5 of this EIS, the region extends 50 mi from the site boundary. Although the review team considered the entire region within a 50-mi radius of the Lee Nuclear Station site when assessing socioeconomic impacts of building activities, the primary focus is on Cherokee and York Counties, both of which are in South Carolina. Based on the size of the resident workforce within commuting distance of the Lee Nuclear Station site, commuter patterns, discussions with local community leaders, and the distribution of residential communities in the area, the review team expects minimal demographic impacts on other counties within the region.

(a) Duke estimated the peak workforce at proposed Lee Nuclear Station Units 1 and 2 (excluding Make-Up Pond C) would occur in month 32 (4512 workers). However, the overall project peak workforce including Make-Up Pond C activities would occur in month 27, with 4613 workers. Duke further estimated that the 4512 workers in month 32 included 4398 construction workers and 114 operations workers, while the month 27 estimate includes 4510 Units 1 and 2-related workers and 103 Make-Up Pond C-related workers. The review team assumes the difference between the 4510 and 4512 estimates to be two operations workers.

Construction Impacts at the Lee Nuclear Station Site

Based on experience with other large construction projects in the region, Duke, together with Shaw Construction, assumed that 30 percent (1350 workers) of the 4501 Lee Nuclear Station Units 1 and 2 and Make-Up Pond C construction workforce would come from within the existing 50-mi region, 70 percent (3151 workers) would move into the region, and 25 percent (788 workers) of those moving into the region would bring a family (Duke 2008b). Based on staffing at its other nuclear stations, Duke estimated 36 percent (40 workers) of operations workers would in-migrate and each one of them would bring a family (Duke 2009c). Using the average household size in the United States of 2.6 people, 788 construction workers and 40 operations workers would bring an additional 1325 family members, for a total of 2153 people. Together with the remaining in-migrating workers (2363 workers), the total in-migrating population would be 4516 when families are considered.

As indicated in Section 2.5.1.1, the populations of Cherokee and York Counties are 55,342 and 226,073, respectively. The South Carolina Budget and Control Board (SCBCB) baseline population estimates for Cherokee and York Counties are expected to increase steadily between 2010 and 2035 (see Table 2-16). The SCBCB projected population levels in 2015 for Cherokee and York Counties are 58,780 and 235,930, respectively. Although not all in-migrating project workers would reside in York and Cherokee Counties, the review team anticipates that the majority of in-migrating workers would move into these two counties because of their relative proximity to the site. Any remaining workers choosing to reside in the rest of the 50-mi region would be easily absorbed by the larger populations of those counties. Therefore, as an upper bound estimate for the impacts of the in-migrating workers, the review team made the simplifying assumption that all in-migrating workers (building and operations) would move into either Cherokee or York County. For this analysis, the review team assumed that 50 percent would settle in Cherokee County and 50 percent in York County. The influx of project workers and families would represent less than a 4 percent increase in population in Cherokee County and less than 1 percent increase in population in York County based on 2015 SCBCB population projections. Given the large populations of surrounding counties, the review team expects any impacts to all counties within 50 mi of the Lee Nuclear Station site to be minimal and temporary. Therefore, the review team anticipates any population impacts of project activities in Cherokee and York Counties and the remainder of the 50-mi region would not be noticeable and demographic impacts would likely be minor and temporary.

Based on the information provided by Duke and the review team’s independent evaluation, the review team concludes that population impacts of construction and preconstruction would be SMALL and no mitigation would be warranted. NRC-authorized construction activities would represent a large fraction of the analyzed activities; however, the NRC staff concludes that the population impacts of NRC-authorized construction activities would also be SMALL. The NRC staff also concludes that no mitigation measures would be warranted.

4.4.3 Economic Impacts on the Community

This section evaluates the economic impacts of building proposed Lee Nuclear Station Units 1 and 2 on the 50-mi region, focusing primarily on the two-county economic impact area of Cherokee and York Counties. The evaluation assesses the impacts of building activities and demands placed by the larger workforce on the surrounding region.

4.4.3.1 Economy

The impacts of building activities on the local and regional economy depend on the region's current and projected economy and population. Characteristics of the economy and workforce in the region are described in Section 2.5.2 of this EIS. At its peak, the project workforce is estimated to require approximately 4613 workers. Building activities would be staggered by one year between Units 1 and 2, which helps avoid dramatic swings in employment. The Lee Nuclear Station COL, if approved, would give Duke up to 20 years to begin building activities.

For this analysis, the review team based its analysis upon the latest information provided by Duke and assumes building activities would last approximately 93 months with a commercial operation date of 2024 for Unit 1 and 2026 for Unit 2 (Duke 2013b).

The in-migration of approximately 3191 workers (i.e., 3151 construction workers and 40 operations workers), some bringing their families, would create new indirect jobs in the area. Through a process called the "employment multiplier effect," a new (direct) job in a given area stimulates spending for goods and services that results in the economic need for a fraction of a new (indirect) job, typically in service-related industries. The cumulative effect of a new direct job workforce being added to an economy induces the creation of a number of new indirect jobs. The ratio of new jobs (direct plus indirect) to the number of new direct jobs is called the "employment multiplier."

In addition, spending by construction workers and contractors during building stimulates additional spending through a second multiplier effect, where each dollar spent on goods and services by one person becomes income to another, who saves some money but re-spends the rest. In turn, this re-spending becomes income to someone else, who in turn saves a portion and re-spends the rest, and so on. The percentage by which the sum of all spending exceeds the initial dollar spent is called the "earnings multiplier." The U.S. Department of Commerce Bureau of Economic Analysis (BEA), Economics and Statistics Division, provides regional multipliers for industry jobs and earnings and a custom set of multipliers was provided by BEA for the two-county economic impact area.

The Regional Input-Output Modeling System (RIMS II) employment multiplier for construction jobs in the economic impact area is 1.617 (BEA 2011), meaning that for each direct job created a total of 1.617 jobs (including the direct job) would be supported in the two-county economic impact area. The employment multiplier for operations jobs during the building phase (primarily operations workers training to begin operations once the two units are completed) is 2.165. In the case of the Lee Nuclear Station, the total 4613 workers at the project peak would support a total of 2908 indirect jobs in the two-county economic impact area. The 3191 in-migrating direct jobs at the project peak would generate 1991 indirect jobs in the two-county economic impact area. Only the in-migrating direct jobs are counted so that a net impact can be estimated. Indirect and induced jobs are assumed to be allocated to area residents who were either unemployed or leaving other jobs to take Lee Nuclear Station-related employment.

The employment of a large workforce over approximately 7.75 years would have positive economic impacts on the surrounding region. Based on data from the Bureau of Labor Statistics (BLS 2009), the average annual salary for construction workers in South Carolina is approximately $34,500. Assuming a benefits package would double that annual amount to $69,000, the review team estimates that annual earnings for construction workers at peak project employment would be approximately $310.6 million. These earnings inject millions of dollars into the regional economy, thus reducing unemployment and creating business opportunities for housing and service-related industries. The $310.6 million represents the direct income effect of the project to the economic impact area. Applying the income multiplier of 1.588 from RIMS II (BEA 2011), the earnings, including benefits, paid to the project workforce would result in generation of an additional $182.6 million annually in the economic impact area during peak employment years, for a total income effect of $493.2 million. As discussed with employment, the real impact would net out to about half ($246.6 million) because only half of the direct and indirect employment supported by the project would count as an impact on the economic impact area. The largest economic impacts would likely be felt in Cherokee County. Although only a relatively small total population increase would be expected in York County relative to its base population and economy, this increase could produce a noticeable upsurge in the local economy during this period, particularly for the western part of the county. The impacts from workers’ salaries become more diffuse as a result of interacting with the larger economic base of other counties, such as Mecklenburg County. A large quantity of materials are expected to be purchased to assist with building proposed Lee Nuclear Station Units 1 and 2; however, the amount of materials that would be bought locally is unknown. Any annual expenditures by Duke within the region on materials would benefit the local economy.

The review team concludes, based on its independent review of the likely economic effects of the proposed action, that beneficial economic impacts of the proposed action would be experienced throughout the two-county economic impact area. Depending on actual worker relocation patterns the temporary positive economic and employment impacts in Cherokee County would be noticeable and beneficial and minimal in York County. Economic impacts elsewhere in the 50-mi region would be minimal but beneficial.

4.4.3.2 Taxes

The tax structure of the region is discussed in Section 2.5.2.2 of this EIS. Several tax revenue categories would be affected by building proposed Lee Nuclear Station Units 1 and 2. These include income taxes on wages, salaries, sales and use taxes on corporate and employee purchases, and personal property taxes associated with employees.

South Carolina has personal and corporate income taxes. Project workers would pay taxes to the State of South Carolina on their wages and salaries if their residences are in South Carolina, or if they are nonresidents working in South Carolina and filing a Federal return that would include income from personal services rendered in South Carolina (SCDOR 2008). The impact of these taxes would be small for all counties within the 50-mi region of the Lee Nuclear Station site because the taxes are paid to the State. The number of workers that would in-migrate from out of state is unknown; however, given South Carolina's large tax base, the newly created jobs would have a minimal impact on State revenues. Though millions of dollars in income taxes would be generated from employee earnings, a majority of the revenue would have been generated by workers already working in South Carolina at some place other than the Lee Nuclear Station. Therefore, the review team considers the wages of South Carolina residents who would work at the proposed site to be a net transfer with no analytical worth.

The area around the proposed site would experience an increase in sales and use taxes generated by retail expenditures (e.g., restaurants, hotels, merchant sales, food) by the workforce. The region also would experience an increase in the sales and use taxes collected from materials and supplies purchased by Duke for the project. Duke's regional annual expenditures for materials are not known (Duke 2009c). Given its proximity to the proposed site and relatively small population and economic base, Cherokee County probably would receive the largest benefit from sales tax revenues. York County may also experience an increase in sales and use revenues. However, it would likely be a much smaller percentage because of the larger sales and use tax base in the county.

In addition, the State would experience an increase in the sales and use taxes collected from building materials and supplies purchased for the project and workers spending their incomes on goods and services in South Carolina. These revenues would likely be generally proportional to the wages paid to workers at proposed Lee Nuclear Station Units 1 and 2, increasing through the peak of building activities and then declining until stabilizing after completion of these activities.

Cherokee County has an agreement with Duke to make payments in-lieu-of taxes, provided the overall investment in the project is at least $2.5 billion. However, this would not go into effect until operations begin. As a part of this tax agreement, all building activities are exempted. No property taxes would be collected in regard to the Lee Nuclear Station during its development. Therefore, the value of the property does not change during building activities, and Duke would continue to pay taxes on the property itself for the duration of building activities. A second source of revenue from property taxes would be from housing purchased by the workforce. In-migrating workers may construct new housing, which would add to the counties' taxable property base, or these workers could purchase existing houses, which could drive housing demand and housing prices up, thus slightly increasing values (and property taxes levied). The increased housing demand would have little effect on tax revenues in the more heavily populated jurisdictions.

Based on this assessment, the review team concludes that the potential impact of taxes within the region because of the project activities would be minimal and beneficial. The impact within Cherokee County, where the units would be located, also would be minimal and beneficial because the review team expects most tax impacts to occur during the operations phase.

4.4.3.3 Summary of Economic Impacts on the Community

Based on the information provided by Duke, interviews with local public officials, and the review team's own independent review of data of the regional economy and taxes, the review team concludes that the fiscal impacts of construction and preconstruction activities on the regional and state economy and tax base from building proposed Lee Nuclear Station Units 1 and 2 would be SMALL and beneficial. NRC-authorized construction activities represent a large fraction of the analyzed activities; however, the NRC staff concludes that the fiscal impacts of construction activities would also be SMALL and beneficial.

4.4.4 Infrastructure and Community Services Impacts

Infrastructure and community services include transportation, recreation, housing, public services, and education, as described in the following sections.

4.4.4.1 Traffic

This section deals with the infrastructure impacts of the traffic generated by building activities. Air-quality impacts of transportation are addressed in Section 4.4.1 and the human health impacts are addressed in Section 4.8.3.

The impacts of the proposed project on transportation and traffic would be most obvious on the rural roads of Cherokee County, specifically McKowns Mountain Road, a two-lane county road that provides the only access to the Lee Nuclear Station site. Building-related impacts on traffic are determined by six elements:

1. number and timing of non-Lee Nuclear Station site traffic
2. number and timing of project worker vehicles on the roads per shift
3. number of shift changes for the workforce per day

4. number and timing of truck deliveries to the site per day
5. projected population growth rate in Cherokee County
6. capacity and usage of the roads.

McKowns Mountain Road is a two-lane road that provides the only access to the Lee Nuclear Station site. Approximately 74 residences exist along McKowns Mountain Road and it provides egress to SC 105 and SC 329 for approximately 250 residences, 3 churches, 1 business, and 1 fire station (Duke 2008l).

Duke commissioned a traffic study in 2007 to study the impacts of building proposed Lee Nuclear Station Units 1 and 2. A continuation of the 2007 study was completed in 2011 (Duke 2012k). The study analyzed and provided improvements for the following intersections:

- Shelby Highway and Interstate 85 (I-85) northbound and southbound ramps
- SC 329 and Shelby Highway
- SC 329 and US-29
- SC 329
- SC 329 and McKowns Mountain Road
- McKowns Mountain Road and Darwin Road/Rolling Mill Road
- McKowns Mountain Road and Patrick Road
- McKowns Mountain Road and Sardis Road
- McKowns Mountain Road and Site Drive.

The most recent traffic study was based on a maximum workforce size of 5000 workers, with the workforce split into two shifts, 70 percent on the dayshift and 30 percent on the nightshift and a 1.4-person vehicle occupancy. The original study concluded that with a single dayshift or with staggered dayshifts without mitigation, major intersections near the Lee Nuclear Station site would operate at a level of service (LOS) F, which would fail to meet SCDOT minimum acceptable LOS of D or above (Duke 2008l). The more recent transportation study outlines several improvements, confirmed by the SCDOT, to increase capacity on the roads between I-85 and the site. These recommendations include installing traffic signals at the SC 329 and McKowns Mountain Road, Darwin Road/Rolling Mill Road, Patrick Road, and Site Drive, providing additional storage for intersections and additional turning lanes for some intersections. Large deliveries would use the railroad spur and a second site entrance, further east off McKowns Mountain Road, would be built for heavy deliveries. Additional mitigation measures, if needed, could include encouraging carpooling and scheduling deliveries to avoid shift change or high commute times (Duke 2012k).

The SCDOT estimates the capacity on a two-lane highway at 1700 vehicles per hour for each direction and 3200 vehicles per hour for both directions. The 2006 Average Annual Daily Traffic (AADT) report indicates approximately 950 vehicles per day travel McKowns Mountain Road between SC 105 and the end of the road near the Broad River (Duke 2009c). Using assumptions for the most recent traffic study discussed above, the maximum traffic on McKowns Mountain Road would be 1307 vehicles.

Based on information provided by Duke and the review team's own independent review, including visits to the site and affected communities, the review team concludes that during peak site employment, traffic from Lee Nuclear Station site activities would have locally noticeable impacts in the immediate vicinity of the site and for residents on McKowns Mountain Road and minimal impacts on other roadways in the region. These impacts would be largely temporary and of short duration, based on the size of the workforce during any one period, and would have lesser impacts before and after peak employment. As mentioned in the previous paragraph, Duke has identified several planned mitigation measures to minimize the building-related impacts on traffic. Therefore, the review team concludes that traffic impacts in the vicinity of the Lee Nuclear Station site would be noticeable, but not destabilizing. The rest of the region would experience little to no traffic-related impacts.

Norfolk Southern Railroad Company owns and operates the primary freight rail that passes 5.5 mi from the Lee Nuclear Station site on its route from Atlanta, Georgia, to Charlotte, North Carolina. This line averages 22 trains per day. An abandoned railroad spur connects the main line to the Lee Nuclear Station site. Duke plans to reactivate this spur before building and operations begin. Reactivating this spur would require upgrading ballast and track mostly within the existing corridor (Section 2.2.3.2). The Lee Nuclear Station site cannot be accessed by barge because of downstream dams (Duke 2009c). Building activities would not affect commercial rail traffic and given that reactivating the railroad spur would occur mainly in the existing corridor, the review team expects that the impacts from rail and waterway activities related to the Lee Nuclear Station site would be minimal.

4.4.4.2 Recreation

Impacts on recreation may result from increased demand/use of existing and planned resources and from aesthetic/visual and noise impacts, which were discussed earlier in Section 4.4.1. The increase in demand on existing or planned resources would result from usage by in-migrating workers and their families in the region. As discussed in Section 2.5.2.4, a variety of recreation areas exist in the region, including national, state, and local parks and public and private facilities that support outdoor activities (e.g., recreational boating and fishing on the Broad River and Ninety-Nine Islands Reservoir, camping, and hunting). The review team expects that recreationists would not be precluded from hunting, fishing, or other outdoor recreation activities in the vicinity of the site as a result of building proposed Lee Nuclear Station Units 1 and 2.

The site is bounded by woods and water features. Therefore, recreationalists using the Broad River and Ninety-Nine Islands Reservoir directly adjacent to the Lee Nuclear Station site would have visual access to building activities. Those farther away on the Broad River and those using other recreational areas, such as local parks in Gaffney, South Carolina, and Kings Mountain State Park, may be able to view the meteorological tower and cranes. Recreational activities on the Broad River, primarily along the northern property line, may be affected by site-development noise. Those seeking access to the Broad River or Ninety-Nine Islands Reservoir via McKowns Mountain Road may be affected by the project workforce traffic to the site. In the context of recreational experience, aesthetic, and noise impacts of building activities would be localized near the site and isolated from most recreation areas except for the Broad River and Ninety-Nine Islands Reservoir. Therefore, the review team anticipates that the impacts on local recreation from building activities would be minimal.

There are no current recreational activities occurring within the Make-Up Pond C area (Duke 2010r). Once the pond is inundated, it would become private and no recreational activities would be allowed (Duke 2009b). The review team expects the building and inundation of Make-Up Pond C would have a minimal impact on recreation.

4.4.4.3 Housing

Regional housing characteristics and availability are described in Section 2.5.2.5 and Table 2-23. The assumptions behind the review team's estimated in-migration of workers were established in Section 4.4.2. If the entire workforce required to build proposed Lee Nuclear Station Units 1 and 2 were to originate from within a reasonable commuting distance of the site, there would be no impact on housing demand. However, the review team expects that approximately 3151 construction workers (70 percent of the total anticipated workers) plus 40 operations workers (36 percent of the 112 operations workers expected at during peak project activities) would in-migrate into Cherokee and York Counties, the review team estimated that half of the workers would live in Cherokee County and half of them would live in York County. Construction workers may choose to rent housing, stay in hotels/motels, or stay in campers or mobile homes, while operations workers are likely to purchase housing. According to the 2006–2010 American Community Survey, 11,049 housing units in the two-county impact area are vacant: 2850 and 8199 in Cherokee and York Counties, respectively (USCB 2010e). Based on these statistics from the U.S. Census Bureau, Cherokee and York Counties have enough additional capacity to house the in-migrating workers.

Approximately 86 housing structures were demolished and removed from the Make-Up Pond C site (Duke 2012b). Duke provided relocation assistance to property owners and renters located within, or adjacent to, the Make-Up Pond C site. After Duke purchased their homes, current residents were allowed to stay up to 18 months rent-free to find new housing. For owners, relocation expenses were included in the selling price. Most rentals were month to month or week to week rentals and occupants were given at least a 30-days' notice to vacate

(Duke 2009b). In 2010, local officials stated that most individuals relocated from the Make-Up Pond C area found other available housing within Cherokee County (NRC 2010c).

In 2008, local officials in Cherokee County stated the current rental stock was limited, but new apartments were being constructed on South Carolina Highway 11 and that individuals were considering constructing trailer parks in the area (NRC and PNNL 2008). According to York County officials, several newer residential developments exist in the area. York County officials believe that hotel rooms in York County would fill up during the proposed Lee Nuclear Station Units 1 and 2 building phase and outages because all were booked up during nearby Catawba Nuclear Station outages. Officials also noted that an overflow of workers would probably live in Cleveland County, North Carolina, because it has available rental stock (NRC and PNNL 2008).

The boom-and-bust nature of large-scale construction projects aggravates the housing impacts in local communities. The typical pattern begins when in-migrating workers and their families (along with local residents with enhanced economic resources because of project- and worker-related jobs and expenditures) increase the demand for housing. Increased demand creates upward pressure on both the housing supply and prices in the local area. When construction ends, most in-migrating workers leave, and most local indirect jobs also are lost. Because part of the workforce already lives locally, many of these impacts could be avoided.

Building the Lee Nuclear Station could affect housing values in the vicinity of the Lee Nuclear Station site. In a review of previous studies on the effect of seven nuclear facilities, including four nuclear power plants, on property values in surrounding communities, Bezdek and Wendling (2006) concluded that assessed valuations and median housing prices have tended to increase at rates above national and State averages. Clark et al. (1997) similarly found that housing prices in the immediate vicinity of two nuclear power plants in California were not affected by any negative imagery of the facilities. These findings differ from studies that looked at undesirable facilities, largely related to hazardous waste sites and landfills, but also including several studies on power facilities (Farber 1998) in which property values were negatively affected in the short-term, but these effects were moderated over time. Bezdek and Wendling (2006) attributed the increase in housing prices to benefits provided to the community in terms of employment and tax revenues, with surplus tax revenues encouraging other private development in the area. Given the findings from the studies discussed above, the review team determines that the impact on housing value from building the Lee Nuclear Station would be minor.

Based on the information provided by Duke, interviews with local real estate agents and city and county planners, and the NRC's own independent review, the review team expects the housing related impacts of building proposed Lee Nuclear Station Units 1 and 2 would be minimal and temporary for the region and in Cherokee and York Counties, and additional mitigation would not be warranted.

4.4.4.4 Public Services

This section describes the public services available and discusses the impacts of building proposed Lee Nuclear Station Units 1 and 2 on water supply; waste treatment; police, fire and medical services; education; and social services in the region.

Water-Supply Facilities

The demand on potable water utilities would increase at the Lee Nuclear Station site during the building phase. A detailed description of project-related water requirements and resulting impacts is presented in Section 4.2. Proposed Lee Nuclear Station Units 1 and 2 would get potable water from the Draytonville Water system to support project activities. Municipal water users in Cherokee County currently consume 8 Mgd compared to the water-supply plant capacity of 18 Mgd. Information about water-supply providers in York County is limited, but York County's largest water supplier is the City of Rock Hill, which has an estimated 4 Mgd of extra capacity (Duke 2009c). The recommended usage requirement for estimating potable water consumption for workers in hot climates is 30 gpd for each worker, which includes drinking water and sanitary needs (Duke 2009c). At peak employment, with 4613 construction and operations workers, there would be a total demand of 138,390 gpd. Using a USGS average per capita amount of water consumed per day of 90 gallons, the overall increase in consumption is 406,440 gpd from the additional population of 4516 from the in-migrating population. For the purposes of this EIS, the review team considers the 30 gpd worker demand to be in addition to the USGS 90 gpd estimate as an upper bound in determining impacts, for a total of 544,830 gpd of water usage. This is well within the excess capacity of local water suppliers in Cherokee and York Counties. A letter from officials at the Draytonville Water Works to Duke dated June 7, 2010, states that no system improvements or capacity increases are needed (Duke 2010h). As discussed in Section 4.2.2, the review team does not expect project activities to affect groundwater or wells in the region. Therefore, the review team concludes that the impacts of building proposed Lee Nuclear Station Units 1 and 2 on water systems would be minimal, and mitigation would not be warranted.

Wastewater-Treatment Facilities

Cherokee County, South Carolina, has two wastewater-treatment facilities with a combined maximum capacity of 9 Mgd. The first facility, Clary Wastewater Treatment Plant, operates at 60 percent capacity, and the Broad River Wastewater Treatment Plant operates at 40 percent capacity. York County's three wastewater-treatment plants have 5.3 Mgd of extra capacity and could also accommodate the extra population. Wastewater-treatment facilities in the two counties have enough additional capacity to treat the entire 544,830 gpd used by workers at the site and the increased in-migrating population. Proposed Lee Nuclear Station Units 1 and 2 would use the Broad River Wastewater Treatment Plant for wastewater needs. In a letter dated June 7, 2010, Gaffney Board of Public Works officials stated that the Broad River Wastewater

Treatment Plant will undergo an upgrade to meet the additional capacity (Duke 2010h). The review team concludes the impacts of building the Lee Nuclear Station on wastewater-treatment facilities would be minimal and mitigation would not be warranted.

Police, Fire and Medical Services

A temporary increase in population from the project workforce for a new nuclear facility could increase the burdens on local fire and police departments, but this increase would be transitory. After the project has been completed, many of the workers would leave the area, relieving those burdens. During the building phase, the temporary increase in demand for community resources could be mitigated in several ways. Larger communities would have an easier time assimilating the influx of new people because the additional new population composes a smaller percentage of the communities' base populations. Likewise, the more communities that host new workers, the less pressure each individual community would experience on its infrastructure. Consequently, any incentives Duke can provide its employees to move into the area in a planned manner would mitigate, but not remove, this short-term demand. Next, communities can avoid the long-term commitment to the maintenance and operation of infrastructure purchases to fulfill short-term demand increases. Instead of purchasing new fire or police equipment, affected communities could lease vehicles or building space.

Cherokee and York Counties employ an estimated 96 and 307 police officers, respectively. The resident-to-police officer ratios in Cherokee and York Counties are 570:1 and 739:1, respectively (Duke 2009c). Assuming that half of the new population live in Cherokee County and the other half live in York County, the respective resident-to-police officer ratios increase to 593:1 and 747:1. Cherokee County has 350 firefighters and York County has 688 firefighters (Duke 2009c). The current resident-to-firefighter ratios are 155:1 and 210:1 for Cherokee and York Counties, respectively. With the increased population, the ratios would rise to 161:1 and 212:1, respectively. The U.S. military has established a ratio of 1 to 4 officers per 1000 citizens (between 1000:1 and 250:1) as generally acceptable levels. With the increased population, the ratios for Cherokee and York Counties are still within acceptable levels. The Draytonville-McKowns Mountain-Wilkinsville Volunteer Fire Department would respond to fires onsite during building activities. Prior to nuclear fuel receipt, an onsite fire brigade is expected to be in place (Duke 2009c). Demands for any new services associated with building proposed Lee Nuclear Station Units 1 and 2 would be readily absorbed by the increase in revenue associated with general growth in the local area. The review team concludes the building-related impacts on fire and police services in Cherokee and York Counties would be minimal and temporary.

Cherokee County has one hospital, Upstate Carolina Medical Center, located in Gaffney, South Carolina. It has 125 beds and nearly 100 medical staff. There are no medical facilities in York County within 10 mi of the Lee Nuclear Station site. However, Piedmont Medical Center is just outside the 10-mi radius and has an existing agreement with Duke to provide emergency medical care for radiological contaminated employees at the Catawba Nuclear Station.

Piedmont Medical Center would also be used by Lee Nuclear Station as part of this agreement (Duke 2009c). Based on the size and availability of medical services in the region, temporary construction workers would not overburden existing medical services. The review team concludes adverse impacts on medical services near the proposed site would be minimal and temporary.

Social Services

Social services such as adoptions, child protective services, family nutrition programs, foster care services, foster home and group home licensing, and food stamps are overseen by the South Carolina Department of Social Services (SCDSS). Social services, such as Medicaid and welfare, are funded through the Federal and State governments. In addition to government-provided services, a number of private, philanthropic, and religious organizations that provide social services within the 50-mi radius of the Lee Nuclear Station site. To the extent Duke's contractors hire individuals who use the services provided by the SCDSS or nonprofit organizations, building proposed Lee Nuclear Station Units 1 and 2 could reduce the burden on social service providers. The enhanced employment opportunities created by the multiplier effect during the project may provide some benefits to the disadvantaged population. However, new families moving into a community would bring new demand for both State and privately provided social services. Overall, the counterbalancing effects of new jobs and new families cannot be fully quantified. As the project nears completion and direct and indirect jobs are lost, demands on social services may increase. The review team concludes the overall impact of building proposed Lee Nuclear Station Units 1 and 2 on social services would be minimal.

4.4.4.5 Education

The percentage of school-aged children between ages 5 and 18 in Cherokee and York Counties is 19 and 18 percent, respectively (Duke 2009c). The review team expects a net building-related increase of about 398 (total in-migrating workers of 828 who bring a family multiplied by the average of 18.5 percent) school-age children. Further, the review team assumes that 50 percent of the in-migrants would settle in Cherokee County and 50 percent would settle in York County, which translates to approximately 200 additional students in each county. Based on the student populations of the school districts presented in Section 2.5.2.7 and Table 2-27 the increased student populations would represent a less than 5 percent increase in student body populations. The Cherokee County School District has recently undergone renovations, and Gaffney high school has room for an additional 1000 students. York County District One is currently undergoing renovations and should not have to worry about capacities for 15 years. According to school district officials, building proposed Lee Nuclear Station Units 1 and 2 would not have a disrupting effect on school districts in either county (NRC and PNNL 2008). Based on Duke's analysis, a discussion with local officials, and the review team's analysis, the review team concludes the impact on education would be minimal.

4.4.4.6 Summary of Infrastructure and Community Services Impacts

The review team has evaluated information provided by Duke, information obtained at the site visit, interviews with county officials and leaders, and performed an independent review of potential infrastructure and community service impacts from building proposed Lee Nuclear Station Units 1 and 2. The review team concludes that impacts on regional infrastructure and community services, including recreation; housing; water and wastewater facilities; police, fire, and medical facilities; social services; and education would be minimal with one exception. The estimated peak workforce of 4613 during construction and preconstruction activities would have a MODERATE temporary and adverse impact on traffic on local roads near the site especially on McKowns Mountain Road, and a minimal and adverse impact elsewhere in the region. These conclusions are predicated on the specific assumptions about the size, composition, and behavior of the project workforce discussed in detail in Section 4.4.2. Mitigation beyond the strategies outlined by Duke in its ER would not be warranted. The NRC staff concludes that the infrastructure and community service impacts of NRC-authorized construction activities would be MODERATE for local roads near the site when building proposed Lee Nuclear Station Units 1 and 2, but would be not be noticeable for the region. The NRC staff also concludes that mitigation beyond the strategies outlined by Duke in its ER would not be warranted.

4.5 Environmental Justice Impacts

The review team evaluated whether the health or welfare of minority and low-income populations in the census blocks identified in Section 2.6 could experience a disproportionately high and adverse impact from activities related to building proposed Lee Nuclear Station Units 1 and 2. To perform this assessment, the review team (1) identified all potentially significant pathways for human health and welfare effects, (2) determined the impact of each pathway for individuals within the identified census block groups and other areas identified through the review team's onsite evaluations, and (3) determined whether the characteristics of the pathway or special circumstances of the minority and low-income populations would result in a disproportionately high and adverse impact on any minority or low-income individuals within each census block group.

As discussed in Section 2.6.3, the review team did not find any evidence of unique characteristics or practices in the region that could lead to a disproportionately high and adverse impact on any minority or low-income population.

4.5.1 Health Impacts

The review team determined, through literature searches and consultations with NRC staff health experts that the expected building-related level of environmental emissions is well below the protection levels established by NRC and EPA regulations and would not impose a disproportionately high and adverse radiological health effect on any identified minority or low-income populations. From the review team's investigation, no project-related potential pathways to adverse health impacts were found to occur in excess of the safe levels stipulated by NRC and EPA health and safety standards (Section 4.9.5). The NRC staff determined that the offsite dose rate would also be well below regulatory limits and impacts would be small. The review team's investigation and outreach did not identify any unique characteristics or practices among any minority or low-income populations that would result in disproportionately high and adverse impacts on those populations (NRC and PNNL 2008). No impacts would be expected on migrant farm worker populations even if they were employed near the Lee Nuclear Station site.

As described in Section 4.4.1, the potential environmental and physical effects of building proposed Lee Nuclear Station Units 1 and 2 would be generally confined within the site boundaries with few exceptions, leading to no offsite health impacts on any identified population. Where there would be potential offsite nonradiological health effects, the review team did not identify any studies, reports, or anecdotal evidence that would indicate any environmental pathway that would physiologically affect minority or low-income populations differently from other segments of the general population during building activities. Moreover, the review team's regional outreach provided no indication in either the location or practices of minority and low-income populations in the 50-mi region that suggests they would experience any disproportionately high and adverse nonradiological impacts. In addition, the review team determined that the nonradiological health effects of building activities and other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts to nonradiological health would be localized and minimal (Sections 4.8.4 and Section 7.7). The review team's investigation and outreach did not identify any unique characteristics or practices among minority and low-income populations that would result in disproportionately high and adverse nonradiological health impacts (NRC and PNNL 2008).

Traffic is a major component of nonradiological health impacts. Any increase in traffic accidents due to heavier traffic is unlikely to have a disproportionately high impact on any particular population subgroup in the 50-mi region or Cherokee County. The roads nearest the plant would be more crowded and more traffic accidents may occur, but these increases are likely to be located on the principal commuting routes, which are not located in communities with minority or low-income populations of interest. No information suggests that nearby minority or low-income communities would be disproportionately vulnerable to hazards while on the road. Finally, as discussed in Section 2.6.3, the review team did not identify any evidence of unique characteristics or practices in any minority or low-income population that may result in different traffic impacts compared to the general population. Therefore, traffic effects would not have a disproportionately high and adverse impact on minority or low-income populations.

4.5.2 Physical and Environmental Impacts

Building a nuclear power station is very similar in its environmental effects to building any other large-scale industrial project. There are four primary pathways in the environment: soil, water, air, and noise. Discussions of the potential impacts on each of these pathways follow.

4.5.2.1 Soil

Building activities at the Lee Nuclear Station site and Make-Up Pond C site represent the largest source of soil-related environmental impacts. However, these impacts would be localized to those two sites, are sufficiently distant from surrounding populations, have little migratory ability, and would be mitigated through strategies implemented by Duke resulting in no noticeable offsite impacts. The review team concludes soil-related environmental impacts during the building of proposed Lee Nuclear Station Units 1 and 2 would have no impacts on any populations within Cherokee and York Counties.

4.5.2.2 Water

Duke would mitigate impacts on surface water, such as the Broad River and Ninety-Nine Islands Reservoir, by implementing the SCDHEC construction SWPPP and complying with required SCDHEC and USACE regulatory permits and applicable conditions specified in these permits (Duke 2009c). As described in Section 4.2, the review team expects project-related impacts on surface water to be minimal because total water demand would represent a small portion of the available water and because there would be minimal surface-water-quality effects. The review team expects all effects on groundwater to be minimal because usage effects would be localized and temporary and there would be no effect on groundwater quality. Therefore, the review team determined the potential negative offsite environmental effects from impacts on water sources would be small; and, consequently, there would be no disproportionately high and adverse water-related impacts on minority or low-income populations.

4.5.2.3 Air

Air emissions are expected from increased vehicle traffic, heavy equipment operations, and fugitive dust generated by project activities. Emissions from vehicles and heavy equipment are unavoidable, but would be localized and temporary. Emissions from fugitive dust would be localized, and dust-control measures would be implemented to maintain compliance with NAAQS. As discussed in Section 2.6.3, the review team did not identify any evidence of unique characteristics or practices in the minority and low-income populations that may result in different air-quality-related impacts compared to the general population (NRC and PNNL 2008). The review team determined the negative environmental effects from building-related reductions in air quality would be small, localized, and short-lived for any population in Cherokee and

York Counties. Consequently, the review team found no disproportionately high and adverse impacts on minority or low-income populations because of changes in air quality.

4.5.2.4 Noise

Noise levels from building activities may exceed 100 dBA within the site, but would be attenuated by distance, vegetation, and topography. Noise from traffic along the access routes to the Lee Nuclear Station site and Make-Up Pond C site may intermittently exceed levels acceptable for residential areas. However, these impacts would be more noticeable within the vicinity of the site or the site access roads. Sensitive noise receptors closest to the site are likely to experience intermittent, but temporary, noise pollution during the peak of building activities. In addition to the findings in Section 4.8 that noise impacts from building activities are temporary in nature, the distance between the site and minority and low-income populations is large. As discussed in Section 2.6, the review team did not identify any evidence of unique characteristics or practices in the minority and low-income populations that may result in a disproportionately high and adverse impact on minority or low-income populations.

4.5.3 Socioeconomic Impacts

Socioeconomic impacts in Section 4.4 were reviewed to evaluate whether any building-related activities could have a disproportionately high and adverse effect on minority or low-income populations. The review team expects traffic to increase beyond the capacity of McKowns Mountain Road during the building phase. However, as discussed in Section 4.4.4.1, Duke has plans to help mitigate the increased traffic congestion. While adverse impacts on traffic would be likely, the review team did not identify any unique characteristics or practices in the low-income and minority populations that could lead to a disproportionately high and adverse impact.

As discussed in Section 2.6, no minority or low-income block groups reside in the vicinity of the Lee Nuclear Station site. The review team expects that potential adverse socioeconomic impacts from building-related activities for the new plant would not affect the low-income and minority populations in the region disproportionately because the review team found no evidence of any unique characteristics or practices among those communities that could lead to a disproportionately high and adverse impact. Consequently, the review team found no evidence of disproportionately high and adverse impacts on minority or low-income populations because of changes in socioeconomic conditions.

4.5.4 Subsistence and Special Conditions

NRC environmental justice methodology includes an assessment of populations of particular interest or unusual circumstances, (e.g., minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements).

As discussed in Section 2.6.1, the review team was made aware of anecdotal evidence of private subsistence fishing among the low-income populations in York County (Niemeyer 2008). However, under closer investigation, no pathways were identified from building activities that would modify or disrupt subsistence fishing in York County. The review team did not identify any unusual resource dependencies (e.g., plants with religious or economic significance or key transportation routes) that might be disrupted by building activities. Therefore, the review team concludes that there would be no disproportionately high and adverse impacts on the subsistence activities of minority or low-income populations from building proposed Lee Nuclear Station Units 1 and 2.

4.5.5 Summary of Environmental Justice Impacts

The review team has evaluated the proposed construction and preconstruction activities related to building proposed Lee Nuclear Station Units 1 and 2 and the potential environmental justice impacts in the vicinity and region. The review team determined there are no environmental, health, or socioeconomic pathways by which the identified minority or low-income populations in the 50-mi region would be likely to suffer disproportionately high and adverse environmental or health impacts as a result of construction and preconstruction activities. Therefore, the review team concludes that the environmental justice impacts of construction and preconstruction activities would be SMALL, and additional mitigation would not be warranted beyond that which Duke has outlined in its ER. Based on the above analysis, and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes there are no environmental pathways by which the identified minority or low-income populations in the 50-mi region would be likely to suffer disproportionately high and adverse environmental or health impacts as a result of the NRC-authorized construction activities. Therefore, the NRC staff concludes that the environmental justice impacts of NRC-authorized construction activities would be SMALL and additional mitigation beyond the strategies outlined by Duke in its ER would not be warranted.

4.6 Historic and Cultural Resources

The National Environmental Policy Act of 1969, as amended (NEPA) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to interested parties. The National Historic Preservation Act of 1966, as amended (NHPA), also requires

Federal agencies to consider impacts on those resources if they are eligible for listing in the National Register of Historic Places (National Register). Such resources are referred to as "historic properties" in NHPA. As outlined in 36 CFR 800.8, "Coordination with the National Environmental Policy Act of 1969," the NRC is coordinating compliance with Section 106 of the NHPA in fulfilling its responsibilities under NEPA.

Construction and preconstruction of new nuclear power plants can affect either known or undiscovered historic and cultural resources. In accordance with the provisions of NHPA and NEPA, the NRC and USACE, a cooperating Federal agency, are required to make a reasonable and good faith effort to identify historic properties and cultural resources in the areas of potential effect (APEs) for construction and preconstruction and, if present, determine if any significant impacts are likely. Identification is to occur in consultation with the appropriate State Historic Preservation Officer (SHPO), American Indian Tribes, interested parties, and the public. If significant impacts are possible, efforts should be made to mitigate them. As part of the NEPA/NHPA integration, even if no historic properties or important cultural resources are present or affected, the NRC and USACE are still required to notify the appropriate SHPO before proceeding. If it is determined that historic properties or important cultural resources are present, efforts must be made to assess and resolve any adverse effects of the undertaking.

Section 2.7 provides a detailed overview of historic and cultural resources at the Lee Nuclear Station site, at proposed project developments in the 6-mi vicinity of Lee Nuclear Station Units 1 and 2, and at proposed project developments in offsite areas. As explained in this discussion, archaeological and architectural surveys have been conducted in all onsite and offsite direct (physical) and indirect (visual) APEs by qualified professional cultural resources contractors and potential effects have been considered for a number of historic properties and cultural resources. As part of these investigations, Duke has established ongoing coordination with the South Carolina SHPO and has shared information with four Federally recognized American Indian Tribes and four Native American organizations (Duke 2008f, g; 2009c, h, l; 2010i, j). Duke has established ongoing communications based on responses received from three interested American Indian Tribes: the Catawba Indian Nation, Eastern Band of Cherokee Indians, and the Seminole Tribe of Florida. The NRC has also invited these tribes and organizations, the South Carolina SHPO, and the Advisory Council on Historic Preservation to participate in the initial and supplemental scoping processes for the environmental review and invited their feedback on the draft EIS (Appendices C and F). The USACE has also engaged Duke, the South Carolina SHPO, the Catawba Indian Nation, and Eastern Band of Cherokee Indians in consultation to develop a cultural resources management plan and Memorandum of Agreement (MOA) for the Lee Nuclear Station site and associated offsite developments.

Largely in response to concerns expressed by the aforementioned consulting parties, Duke Energy has developed a corporate policy for cultural resource protection (Duke 2009c, j) that provides guidance to minimize impacts on cultural resources during activities at all facilities owned and operated by Duke Energy and procedures for handling any inadvertent cultural resource discoveries in consultation with the appropriate SHPO and Tribal Historic Preservation Officer(s) (THPO[s]). In 2013, Duke, the USACE, the South Carolina SHPO, and the Catawba Indian Nation THPO finalized a cultural resources management plan and associated MOA that implement the corporate policy and are tailored specifically to the Lee Nuclear Station site and associated developments (USACE et al. 2013).

To develop the impact assessments presented here, the review team

- analyzed the potential impacts on historic properties and cultural resources resulting from proposed construction and preconstruction activities at the Lee Nuclear Station site and vicinity and in offsite areas as described in the ER, the Make-Up Pond C supplement to the ER, 2013 supplemental information related to site design changes, and cultural resource survey reports
- confirmed Duke Energy's corporate policy for cultural resources consideration and protection and inadvertent discovery procedures
- considered Duke's past and ongoing coordination with the South Carolina SHPO and American Indian Tribes that have expressed interest in the proposed activities
- confirmed the scope of the final cultural resources management plan and associated MOA between Duke, the USACE, the South Carolina SHPO, and the Catawba Indian Nation.

4.6.1 Site and Vicinity Direct and Indirect Areas of Potential Effect

In 1974, archaeological surveys in advance of site-preparation activities related to the unfinished Cherokee Nuclear Station resulted in the documentation of 11 archaeological sites and 1 historic cemetery within the 1900-ac Lee Nuclear Station site (SCIAA 1974). It is likely that 6 of the 11 archaeological sites recorded during the 1974 cultural survey were heavily disturbed by site-preparation activities (Duke 2009c; SCIAA 1981; Brockington 2007a). None of these sites was recommended for further investigations in 1974, indicating that it is unlikely that any were eligible for nomination to the National Register. The remaining five archaeological sites and the historic Stroup Cemetery were probably not affected by the unfinished Cherokee Nuclear Station site-development activities (Duke 2009c). In 1975, the South Carolina SHPO concluded that no National Register properties would be affected by the unfinished Cherokee Nuclear Station (Duke 2009c). No architectural resources or indirect visual effects were investigated at that time.

In cooperation with the South Carolina SHPO in 2007 and 2009, Duke and its primary cultural resources contractor, Brockington and Associates, Inc., defined several onsite direct physical APEs within the 1900-ac Lee Nuclear Station site where ground-disturbing activities associated with building and operating the new units would occur (Brockington 2007a, b; 2009a). Under the guidance of the Lee Nuclear Station site cultural resources management plan and MOA in 2013, additional cultural resource investigations were initiated for updated plans for placement of site-specific structures and associated developments such as spoil and laydown areas and a new railroad turnaround (Brockington 2013). Archaeological surveys and testing within all of the 2007, 2009, and 2013 APEs revealed seven new archaeological sites and eight new isolated artifact locations, all of which were evaluated as ineligible for nomination to the National Register (Brockington 2007a, b; 2009a; 2013). Investigators also revisited the reported locations of two previously recorded archaeological sites that were not expected to have been disturbed by the unfinished Cherokee Nuclear Station preparations, but found no evidence of these resources within the current APEs (Brockington 2009a).

It is unlikely that the historic and cultural resources previously recorded in the 750-ac unfinished Cherokee Nuclear Station site are preserved given the high levels of earlier ground disturbance. Duke's corporate procedure for ongoing cultural resources consideration (Duke 2009j) and the Lee Nuclear Station site cultural resources management plan and associated MOA (USACE et al. 2013) would prompt assessment and coordination with the SHPO if any materials are inadvertently discovered. In 2007, the South Carolina SHPO accepted the Lee Nuclear Station site survey reports without specifically commenting on the eligibility of archaeological sites or the probable destruction of resources originally recorded in the 1970s (SCDAH 2007b). Later, in2009 and 2013, the SHPO concurred with the determination that proposed onsite activities would not adversely affect any historic properties (archaeological in nature) (SCDAH 2009a, 2012a, 2013). Information gathered during the 2007 and 2009 investigations was also provided to the Eastern Band of Cherokee Indians (Duke 2010j) and ongoing consultation resulted in concurrence with the findings of no effect to important resources (EBCI 2011).

Investigators have identified four historic cemeteries within the 1900-ac Lee Nuclear Station site: the Stroup Cemetery, Moss Cemetery, McKown Family Cemetery, and an unnamed cemetery (Brockington 2007a, b; 2009a; 2013). Although these resources are evaluated as ineligible for nomination to the National Register, they are protected by State law, are of importance to the South Carolina SHPO (SCDAH 2012a), and continue to be culturally important to local members of the community as indicated by the periodic requests for access that continue to be received by Duke (Duke 2010d). Under the Lee Nuclear Station cultural resources management plan and associated MOA (USACE et al. 2013), Duke intends to continue to provide public access to these culturally important resources, establish protective 50-ft protective buffers as necessary, and maintain the fences that surround them. Prior to ground disturbance, the cemeteries will be marked for avoidance and they will be periodically monitored by security personnel (Duke 2010d, o). No traditional cultural places of importance to interested American Indian Tribes have been identified at the Lee Nuclear Station site.

In cooperation with the South Carolina SHPO, Duke and its cultural resources contractor, Brockington and Associates, Inc., determined that onsite indirect effects, such as viewshed and noise impacts associated with construction and preconstruction activities at the Lee Nuclear Station site, should be considered for aboveground resources located within a 1-mi radius of the tallest proposed structures, including the nuclear units, associated shield buildings, and the meteorological tower (Brockington 2007a, b; 2009a). As discussed in Section 2.7, field and archival investigations resulted in the documentation of 12 architectural resources and 4 historic cemeteries within this indirect visual APE. Visual impacts were also assessed for one National Register-eligible property, the Ninety-Nine Islands Dam and Hydroelectric Project. Investigators recommended that although the tallest proposed structures (proposed nuclear units and associated containment buildings) would be visible from Ninety-Nine Islands Dam and the Ninety-Nine Islands Hydroelectric Project, these historic properties would not be adversely affected because the visibility of these structures would not alter the characteristics of the dam and powerhouse that make them significant, specifically, their unique design and role in the history of hydropower development in the Piedmont region of South Carolina (Brockington 2007a).

The remaining architectural resources located within the Lee Nuclear Station site indirect visual APE were determined to be ineligible for nomination to the National Register and no potential visual impacts on historic cemeteries were identified. No traditional cultural properties were defined by stakeholders in the onsite direct (physical) or indirect (visual) APEs. Archaeological resources located in the direct physical APEs at the Lee Nuclear Station site and vicinity were evaluated as ineligible for National Register nomination and these resources were not considered as part of the onsite indirect effects assessment because they are typically buried and not subject to visual impacts. As a result, investigators concluded that construction and preconstruction activities at the Lee Nuclear Station site would not alter significant aspects of any National Register-eligible or culturally important resources, a determination supported by the review team’s independent analysis. The South Carolina SHPO concurred with the eligibility assessments and finding of no adverse effects to the National Register-eligible Ninety-Nine Islands Dam and Hydroelectric Project and an overall determination of no historic properties affected for onsite construction and preconstruction activities (SCDAH 2007b, 2009a, 2012a , 2013). The Eastern Band of Cherokee Indians also found that no resources important to the Tribe would be affected (EBCI 2011).

Proposed Make-Up Pond C, located in the Lee Nuclear Station site vicinity within 6 mi of the proposed plant, would support plant operations during extended drought conditions. Cultural resources investigations of Make-Up Pond C and associated developments (i.e., pipelines, road modifications, spoils piles, and laydown areas) were completed in a phased approach (Brockington 2009b, 2010, 2011, 2013) and included archaeological surveys with test excavations, geomorphological testing, archival investigations, and architectural surveys. Direct (physical) and indirect (visual) APEs were defined in coordination with the South Carolina SHPO as a 620-ac reservoir with a 300-ft shoreline buffer (direct APE) and a 1.25-mi zone surrounding this area to encompass potential visual intrusions (indirect APE).

Cultural resources investigations in the direct physical and indirect visual APEs for Make-Up Pond C resulted in the assessment of 13 archaeological sites, 2 historic cemeteries, 28 architectural resources, and 1 possible historic district. All were recommended as being not eligible for nomination to the National Register, leading to a finding of no historic properties affected for Make-Up Pond C and associated developments (Brockington 2009b, 2010, 2011, 2013). However, the Service Family Cemetery and McKown Family Cemetery were identified as significant cultural resources, protected under South Carolina State law (SC Code Ann 16-17-600; SC Code Ann 27-43, summary also found in CSCPA 2005). Investigators recommended that the Service Family Cemetery be relocated in cooperation with interested members of the local community and in compliance with State law in advance of ground-disturbing project activities. It was also determined that a proposed water pipeline and other developments associated with spoil and laydown areas would not affect the McKown Family Cemetery because a 50 ft protective buffer would be established around the perimeter of the resource (Brockington 2011, 2013). The South Carolina SHPO concurred with the finding of no historic properties affected and the recommendation for relocation of the Service Family Cemetery in consultation with SHPO and interested parties (SCDAH 2009b, 2010a, 2011, 2012a). The Eastern Band of Cherokee Indians and Seminole Tribe of Florida also submitted no objections to the findings (EBCI 2010a, 2010b, 2011); STF 2009, 2010).

Although the Service Family Cemetery and McKown Family Cemetery are not eligible for nomination to the National Register, they are culturally important to local members of the community and protected from disturbance and desecration under South Carolina State law (SC Code Ann 16-17-600, SC Code Ann 27-43, summary also found in CSCPA 2005). Duke confirms that periodic requests for access to identified historic cemeteries continue to be received and a descendant of the Service and Gaffney families has contacted Duke's cultural resources contractor, Brockington and Associates, Inc., specifically about the Service Family Cemetery (Duke 2010d). Duke has confirmed that the future relocation of the Service Family Cemetery will be coordinated with the South Carolina SHPO and completed in accordance with State law, which will include cooperation with identified descendants, solicitation of public input, and an approved petition from the local Cherokee County Council for a resolution approving relocation to a predetermined location (Duke 2010d, h). Completion of these activities will ensure that the Service Family Cemetery is reestablished in a place that is acceptable to descendants and local members of the community and will result in impacts on this culturally important resource that will be noticeable, but not destabilizing. These mitigations are included in the Lee Nuclear Station cultural resources management plan and MOA (USACE et al. 2013) and are conditional to the South Carolina SHPO's concurrence with the finding of no adverse effects under NHPA (SCDAH 2012a). No impacts are expected on the McKown Family Cemetery located near a proposed water pipeline associated with Make-Up Pond C and proposed spoil and laydown areas (Brockington 2011, 2013).

4.6.1.1 Summary of Impacts in the Site and Vicinity

For purposes of consultation under Section 106 of the NHPA, the review team concludes that a finding of no historic properties adversely affected by construction and preconstruction activities would be supported by (1) USACE and NRC consultation and Duke's ongoing coordination with the South Carolina SHPO leading to agreement on a finding of no adverse effects to the National Register-eligible Ninety-Nine Islands Dam and Hydroelectric Project; (2) USACE and NRC consultation and Duke's coordination with the South Carolina SHPO and interested American Indian Tribes leading to agreement on findings that none of the archaeological or architectural resources recorded within defined indirect and direct APEs at the Lee Nuclear Station site or Make-Up Pond C site are National Register-eligible and as a result, construction and preconstruction activities in the site and vicinity will have no effects on historic properties or traditional cultural resources; (3) Duke Energy's corporate policy for the protection of cultural resources, including inadvertent cultural resources discovery procedures as implemented through the Lee Nuclear Station cultural resources management plan and associated MOA (USACE et al. 2013); and (4) the review team's independent analysis and consultation.

For the purposes of the review team's NEPA analysis the review team concludes that impacts on historic and cultural resources would be noticeable, but not destabilizing, based on (1) Duke's commitment to allow continued public access to historic cemeteries within the Lee Nuclear Station site, to maintain protective fencing around these sites, and to protect them from damage during current and future land disturbing or building activities; (2) Duke's commitment to follow the requirements of State law and consult with the South Carolina SHPO on the future removal and relocation of the culturally important Service Family Cemetery located in the Make-Up Pond C site; (3) NRC and USACE consultation and Duke's coordination with the South Carolina SHPO and interested American Indian Tribes leading to findings of no additional significant historic or cultural resources affected directly or indirectly by construction or preconstruction activities within the Lee Nuclear Station site or Make-Up Pond C site; (4) Duke Energy's corporate policy for protection of cultural resources and procedures if cultural resources are inadvertently discovered during ground-disturbing activities as implemented through the Lee Nuclear Station cultural resources management plan and associated MOA (USACE et al. 2013); and (5) the review team's independent analysis and consultation. The review team concludes that potential direct and indirect impacts on historic and cultural resources during construction and preconstruction in the 1900-ac Lee Nuclear Station site and Make-Up Pond C site would be MODERATE.

Preconstruction activities associated with Make-Up Pond C are the primary drivers for concluding an impact greater than SMALL for historic and cultural resources at the Lee Nuclear Station site and vicinity. These activities are not part of the NRC action. Therefore, the NRC staff has determined that the above analysis demonstrates that the potential direct and indirect impacts on historic and cultural resources from NRC-authorized construction activities at the Lee Nuclear Station site would be SMALL and no further mitigation would be warranted.

4.6.2 Offsite Direct and Indirect Areas of Potential Effect

As summarized in Section 2.7, in cooperation with the South Carolina SHPO, Duke has initiated specific cultural resources investigations of three main offsite direct physical APEs and corresponding indirect visual APEs: the offsite railroad line (Brockington 2007c), two proposed routes for new 230-kV and 525-kV transmission lines (Routes K and O) (ACC 2009), and proposed transportation improvements at six key intersections near the Lee Nuclear Station site (Duke 2012d).

Background research and surveys in 2007 confirmed that the existing railroad line to the Lee Nuclear Station site passes through a portion of an National Register-listed archaeological site 38CK68 (Ellen Furnace Works), which is significant for its association with early nineteenth-century ironworks important in the industrial development of Cherokee County (Brockington 2007c). No additional historic architectural resources were identified in the indirect visual APE defined as a 300-ft zone on either side of the existing railroad bed. Based on field inspection, the investigators concluded that the portions of the historic Ellen Furnace Works (38CK68) located within the railroad line direct physical APE had been disturbed by previous grading activities associated with the original railroad bed and recommended that activities associated with reactivation of the railroad line would not result in any additional adverse impacts on cultural features or significant aspects of this historic property (Brockington 2007c). The South Carolina SHPO concurred with the findings of no adverse effects on Ellen Furnace Works (38CK68) and no additional historic properties affected by the proposed reuse of the railroad corridor (SCDAH 2008, 2012a).

In 2007, Duke documented general public concerns about potential impacts on historic homes, churches, and cemeteries during community outreach sessions associated with an initial siting study that narrowed the proposed transmission-line corridors to two routes: Route K and Route O (Duke 2007c). In 2009, intensive archaeological investigations were completed in direct physical APEs for each of the proposed transmission-line routes as well as architectural surveys for indirect visual APEs within 0.5 mi of them (ACC 2009). These investigations resulted in the identification of 37 archaeological sites in the direct physical APEs of the two proposed transmission-line routes. One additional previously recorded archaeological site could not be relocated in spite of intensive survey and testing in its reported location. All of the identified archaeological sites exhibited low potential for preserved cultural features or important information and were evaluated as ineligible for nomination to the National Register (ACC 2009). One site in the inventory, 38CK172, is a possible human burial that is not eligible to the National Register, but potentially subject to consideration under State and Federal burial laws (summary in CSCPA 2005, SC Code Ann16-17-600, SC Code Ann 27-43; Native American Graves Protection and Repatriation Act [NAGPRA], 43 CFR Part 10).

The South Carolina SHPO concurred with the determination that the proposed offsite transmission lines would not affect any archaeological properties listed in or eligible for listing in the National Register (SCDAH 2009c, 2012a). The Eastern Band of Cherokee Indians also concurred, but reiterated the need for protection of the possible human burial site, 38CK172 (EBCI 2009). Duke has confirmed that sensitive cultural resources like 38CK172 will be considered during all phases of transmission-line design, installation, and maintenance through inclusion of these resources in project geographic information system maps and establishment of protective 50-ft radius buffers where no towers or poles will be placed and vegetation will be cleared by hand. Aircraft will also be used for routine inspections, eliminating the need for extensive access roads (Duke 2010o, q). These protective measures are implemented in the cultural resources management plan and associated MOA approved by the USACE, Duke, the South Carolina SHPO, and the Catawba Indian Nation THPO (USACE et al. 2013), so no impacts should occur to 38CK172 and the sensitive human remains that may be located there.

During the 2009 investigations, 39 architectural resources were identified within the indirect visual APE for the two offsite transmission-line routes in a zone extending 0.5 mi from the proposed centerlines. Nine of these resources, including the National Register-eligible Ninety-Nine Islands Dam and Ninety-Nine Islands Hydroelectric Project, are also co-located in the onsite indirect APE for the Lee Nuclear Station. As summarized in Section 2.7, most of the architectural properties identified are twentieth-century residences unlikely to yield any additional important information and evaluated as ineligible for National Register nomination (ACC 2009). However, three National Register-eligible properties were documented. These include Ninety-Nine Islands Dam and Hydroelectric Project, important for its association with early development of hydropower in the region, and two historic farmsteads (Smith's Ford Farm and Reid-Walker-Johnson Farm), important for their association with historic settlement and agricultural economies of the mid-eighteenth and early twentieth centuries. Investigators recommended that the new transmission lines would have no effect on the Ninety-Nine Islands properties given their historic association with power generation and transmission (ACC 2009). Analyses of potential visual impacts on the historic farmsteads demonstrated that distance, topography, and vegetation cover would screen these properties from significant visual modifications in their respective viewsheds (Pike Electric 2010). The South Carolina SHPO concurred that the proposed transmission lines would cause no adverse effects on the two historic farmsteads and no effects on any other historic properties, including Ninety-Nine Islands Dam and Hydroelectric Plant (SCDAH 2009c, 2010b, 2012a).

Cultural resource archive reviews of proposed transportation improvements at six key intersections located from I-85 east to the Lee Nuclear Station site resulted in the identification of five archaeological sites evaluated as ineligible for nomination to the National Register. Limited field inspection confirmed that no evidence remains of these resources in the direct APEs for road building and modification. The South Carolina SHPO concurred with the finding of no historic properties listed in or eligible for listing in the National Register within the direct APEs for transportation improvements (SCDAH 2012b).

4.6.2.1 Summary of Offsite Impacts

For the purposes of consultation under Section 106 of the NHPA for offsite developments, the USACE concludes that a finding of no historic properties adversely affected by offsite preconstruction activities would be supported by: (1) USACE consultation and Duke's coordination with the South Carolina SHPO leading to concurrence on findings of no adverse effects on National Register-eligible properties: Ellen Furnace Works located in the railroad corridor APEs and Ninety-Nine Islands Dam and Hydroelectric Project, Smith's Ford Farm, and Reid-Walker-Johnson Farm located in the offsite transmission-line APEs; (2) USACE consultation and Duke's coordination with the South Carolina SHPO and interested American Indian Tribes leading to agreement that none of the other archaeological or architectural resources located within the direct and indirect APEs defined for the railroad corridor, offsite transmission lines, or the offsite transportation improvements are eligible for nomination to the National Register and as a result, no historic properties or traditional cultural properties in those areas would be affected by the proposed activities; (3) Duke Energy's corporate policy for the protection of cultural resources and inadvertent discovery procedures as implemented through the Lee Nuclear Station cultural resources management plan and associated MOA (USACE et al. 2013); and (4) the review team's independent analysis and consultation.

For the purposes of the review team's NEPA analysis, the review team concludes that the construction and preconstruction impacts on historic and cultural resources would be negligible based on (1) Duke's commitment to implement protective measures to avoid impacts on 38CK172, the culturally important potential human burial site located in transmission-line Route O; (2) NRC and USACE consultation and Duke's coordination with the South Carolina SHPO and interested American Indian Tribes leading to findings of no additional significant historic or cultural resources adversely affected directly or indirectly by preconstruction activities within the railroad corridor, offsite transmission-line corridors, or the offsite transportation improvements; (3) Duke Energy's corporate policy for protection of cultural resources and procedures if cultural resources are unexpectedly discovered during ground-disturbing activities as implemented through the Lee Nuclear Station cultural resources management plan and associated MOA (USACE et al. 2013); and (4) the review team's independent analysis and consultation. On these bases, the review team concludes that the potential direct and indirect impacts on historic and cultural resources during construction and preconstruction activities in offsite project areas would be SMALL and no further mitigation beyond that described above would be warranted.

The NRC staff concludes that almost all the impact on historic and cultural resources would be the result of preconstruction activities. Based on this information, the NRC staff concludes that the historic and cultural resources impacts of NRC-authorized construction would be SMALL. As a result, the NRC staff concludes that the impacts analyzed above are outside the scope of the NRC's APE for the Lee Nuclear Station COL review.

4.7 Meteorological and Air-Quality Impacts

Sections 2.9.1 and 2.9.2 describe the meteorological characteristics and air-quality conditions at and around the Lee Nuclear Station site. The primary impacts of building Lee Nuclear Station Units 1 and 2 on local meteorology and air quality would be from dust generated by land clearing and building activities, emissions from equipment and machinery, concrete batch-plant operations, and emissions from vehicles used to transport workers and materials to and from the site.

4.7.1 Construction and Preconstruction Activities

Development activities at the Lee Nuclear Station site would result in temporary impacts on local air quality. Activities including earthmoving, concrete batch-plant operation and vehicular traffic generate fugitive dust (i.e., larger particles such as total suspended particulates and smaller fine particulate matter emissions such as PM_{10} and $PM_{2.5}$. In addition, gaseous emissions from equipment and machinery used in these activities would contain criteria pollutants such as carbon monoxide, oxides of nitrogen, a small amount of sulfur oxides, and volatile organic compounds. As discussed in Section 2.9.2, Cherokee County is an attainment area for all criteria pollutants for which NAAQS have been established (40 CFR 81.341). As a result, a conformity analysis for direct and indirect emissions is not required (40 CFR Part 93). Further, the closest Class 1 Federal Area is more than 50 mi from the Lee Nuclear Station site.

The SCDHEC regulates air pollution and control through Regulation 61-62. Duke has applied for construction air emission permits through the SCDHEC for operation of a concrete batch plant and other construction equipment requiring air permits (Duke 2009c). Prior to beginning construction and preconstruction activities, Duke stated that it would also develop a mitigation plan to minimize impacts on local ambient air quality. This plan would describe the management controls and measures that Duke intends to implement (e.g., phased construction, vehicle maintenance and inspection programs to minimize air emissions) (Duke 2009c). The mitigation plan would also identify specific mitigation measures to control fugitive dust and other emissions. Section 4.4.1.6 of the ER lists mitigation measures specifically related to dust control. These measures include:

- stabilizing construction roads and spoil piles
- limiting speeds on unpaved construction roads
- watering unpaved construction roads
- performing housekeeping (e.g., remove dirt spilled onto paved roads)
- covering haul trucks when loaded or unloaded
- minimizing material handling (e.g., drop heights, double handling)

- ceasing grading and excavation activities during high winds and extreme air pollution episodes
- phasing grading to minimize the area of disturbed soils
- using temporary or permanent vegetation on-road medians and slopes.

Construction and preconstruction activities including on-road construction vehicles, worker vehicles, off-road construction equipment, marine engines, and locomotive engines would also result in greenhouse gas (GHG) emissions, principally carbon dioxide (CO_2). Assuming a 7-year period for construction and preconstruction activities and typical construction practices, the review team estimates that the total construction equipment CO_2 emission footprint for building Lee Nuclear Station Units 1 and 2 would be of the order of 70,000 metric tons (MT) (i.e., an emission rate of about 10,000 MT annually, averaged over the period of construction and preconstruction), compared to a total United States annual CO_2 emission rate of 5,500,000,000 MT (EPA 2011c). Appendix J provides the details of the review team estimate for a reference 1000-MW(e) nuclear power plant. The control strategies to minimize daily emissions of criteria pollutants would also reduce GHG emissions. Based on its assessment of the relatively small construction equipment carbon footprint as compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of GHGs from construction and preconstruction activities would not be noticeable and additional mitigation would not be warranted.

In general, emissions from construction and preconstruction activities (including GHGs) would vary based on the level and duration of a specific activity, but the overall impact is expected to be temporary and limited in magnitude. In its ER, Duke lists several strategies that may be used to limit air-quality impacts, such as phasing construction and preconstruction activities to minimize daily emissions and performing construction vehicle maintenance to improve efficiency. These are best industry practices for reducing emissions for construction projects of a comparable size to the proposed project. A mitigation plan could also include strategies to reduce CO_2 emissions, including keeping equipment in good working order, reducing idling time, using clean diesel technologies, or using alternative fuel vehicles. Additionally, after preconstruction activities such as site clearing and grading are performed, Duke may minimize air-quality impacts by mulching non-marketable timber rather than burning it (Duke 2009c). The review team concludes that the impacts from construction and preconstruction activities on air quality would not be noticeable because appropriate mitigation measures would be adopted.

4.7.2 Traffic

Duke (2009c) reports that the average construction workforce for proposed Lee Nuclear Station Units 1 and 2 would be approximately 4398 workers during a 72-month period with a peak workforce of 4613 workers during month 27. The peak workforce includes 4510 workers related to Units 1 and 2 and 103 workers related to Make-Up Pond C (see Section 4.4.2 for additional details). Most of the work activity is expected to occur during a single 10- to 12-hour shift, with the possibility of an additional shift.

In addition, Duke conservatively estimates about 100 truck deliveries during the workday (Duke 2009c). McKowns Mountain Road is the primary access road to the Lee Nuclear Station site; this road would experience a significant increase in traffic during shift changes that could lead to periods of congestion and decreased air quality. However, the overall impact caused by increased traffic volume and congestion would be localized and temporary. Duke has stated that traffic mitigation measures would be considered to reduce the impact of increased traffic on air quality. These mitigation measures are discussed in Section 4.4.4.1. Mitigation measures proposed by Duke include staggering shifts during building activities, installing additional traffic signals at certain intersections, and encouraging carpooling (Duke 2012k). Additional mitigation measures, if needed, could include scheduling deliveries to avoid shift changes or high commute times (Duke 2012k). As discussed in Section 4.4.4.1, SCDOT established a minimum acceptable LOS of D or above (Duke 2008l). Without the traffic mitigation measures proposed by Duke, major intersections near the Lee Nuclear Station site would not meet this LOS.Workforce transportation would also result in GHG emissions, principally CO_2. Assuming a 7-year period for construction and preconstruction, and a typical workforce, the review team estimates that the total workforce CO_2 emission footprint for building Lee Nuclear Station Units 1 and 2 site would be of the order of 300,000 MT (i.e., an emission rate of about 43,000 MT annually, averaged over the 7-year period); again, this is compared to a total United States annual CO_2 emission rate of 5,500,000,000 MT (EPA 2011c). Several of the strategies described as possible traffic mitigation options (e.g., use of carpools) would also lead to reduced CO_2 emissions. Appendix J provides the details of the review team estimate of CO_2 emissions for a reference 1000-MW(e) nuclear power plant.

Based on its assessment of the relatively small construction workforce carbon footprint compared to the United States annual CO_2 emissions, the review team concludes that the atmospheric impacts of GHGs from construction workforce transportation would not be noticeable and additional mitigation would not be warranted. Based on Duke's requirement to develop traffic mitigation measures (Duke 2012k) in order to meet SCDOT's minimum LOS for major intersections, the review team concludes that the impact on the local air quality (including the effects of GHG emissions) from the increase in vehicular traffic related to construction and preconstruction activities would be temporary and minimal because appropriate mitigation measures would be adopted.

4.7.3 Summary of Meteorological and Air-Quality Impacts

Based on information provided by Duke and the review team's independent evaluation of the potential impacts on air quality from construction and preconstruction activities associated with proposed Lee Nuclear Station Units 1 and 2, the review team concludes that the impacts on air quality from criteria pollutants and CO_2 emissions would be SMALL and that no further mitigation, other than that proposed by the applicant, would be warranted. Based on the above analysis and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the air-quality impacts of NRC-authorized construction activities would also be SMALL; the NRC staff also concludes that no further mitigation, beyond the applicant's commitments, would be warranted. The ER (Duke 2009c) is silent regarding meteorological impacts associated with site-preparation and development activities. Nevertheless, based on the review team's evaluation, the activities during this phase of the project would have a negligible impact on meteorological conditions.

4.8 Nonradiological Health Impacts

Nonradiological health impacts on the public and workers from site preparation, building activities, and the transport of materials and personnel to and from the site, include exposure to dust and vehicle exhaust, occupational injuries, and noise. The area around the Lee Nuclear Station site is predominantly rural with a population of approximately 43,132 people living within 10 mi of the site (Duke 2009c). No significant industrial or commercial facilities are currently located or planned within 5 mi of the site (Duke 2009c). People who are vulnerable to nonradiological health impacts from site-preparation and building-related activities include people working or living in the vicinity or adjacent to the site; transient populations in the vicinity (i.e., temporary employees, recreational visitors, tourists); and construction workers and personnel working at the Lee Nuclear Station site. The following sections discuss the results of the review team's assessment of nonradiological health impacts from construction and preconstruction of proposed Lee Nuclear Station Units 1 and 2.

4.8.1 Public and Occupational Health

This section includes a discussion of the impacts of building the proposed Units 1 and 2 on public nonradiological health and the impacts from site preparation and development on worker nonradiological health. Section 2.10 provides background information on the affected environment and nonradiological health at and within the vicinity of the Lee Nuclear Station site.

4.8.1.1 Public Health

Impacts on the public from site-preparation and/or development activities at the Lee Nuclear Station could include dust and vehicle exhaust, and operation of the concrete batch plant, as sources of air pollution. If the project is not completed, similar activities associated with redress would be expected (Duke 2009c). In its ER, Duke (2009c) stated that operational controls would be imposed to mitigate dust emissions (i.e., stabilizing construction roads and spoils piles, limiting speeds on unpaved construction roads, periodically watering unpaved roads, covering haul trucks, minimizing material handling, ceasing grading and excavation activities during periods of strong winds and extreme air pollution episodes, phasing grading to minimize the area of disturbed solids, and revegetating road medians and slopes).

Construction Impacts at the Lee Nuclear Station Site

The Lee Nuclear Station site would be located in Cherokee County, South Carolina, which is currently classified as an attainment area for NAAQS. Regional air quality is discussed in Section 2.9 of this EIS, and impacts on air quality from building activities is discussed further in Section 4.7. Duke stated that applicable Federal, State, and local emission requirements would be adhered to as they relate to open burning or the operation of fuel-burning equipment. Appropriate Federal, State, and local permits and operating certificates would be obtained as required (Duke 2009c). Engine exhaust would be minimized by maintaining fuel-burning equipment in good mechanical order (Duke 2009c).

Particulates resulting from operation of the concrete batch plant would be another potential source of nonradiological health impacts. Duke would operate the batch plant under an air permit issued by the SCDHEC that would specifically apply to the batch plant, and would employ particulate controls required by the permit (Duke 2009c).

The public would not be allowed close to the Lee Nuclear Station site. The nearest accessible area would be the Pick Hill boat access on the east bank of the Ninety-Nine Islands Reservoir, approximately 0.4 mi from the Lee Nuclear Station site (Duke 2009c). The nearest residence is approximately 0.99 mi from the Lee Nuclear Station site (Duke 2013d). Based on the mitigation measures identified by Duke in its ER, the permits and authorizations required by State and local agencies, and the review team's own independent review, the review team concludes that the nonradiological health impacts on the public from site-preparation and building activities would be negligible and that additional mitigation beyond the actions identified above would not be warranted.

4.8.1.2 Construction Worker Health

U.S. Bureau of Labor Statistics reports take into account occupational injuries and illnesses as total recordable cases, which includes cases that result in loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid. The review team estimated the annual number of recordable cases based on U.S. and South Carolina total recordable case rates for the year 2009. The 2009 recordable incidence rates in utility construction (the number of injuries and illnesses per 100 full-time workers) for the U.S. and South Carolina were 3.8 and 2.8, respectively (BLS 2010a, b). Duke (2009c) reports that the average construction workforce for proposed Lee Nuclear Station Units 1 and 2 would be approximately 4398 workers during a 72-month period with a peak workforce of 4613 workers during month 27 (see Section 4.4.2 for workforce details). Based on this assessment, an estimated 129 occupational illnesses or injuries could occur each year.

Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards, practices, and procedures. Appropriate State and local statutes also must be considered when assessing the occupational hazards and health risks associated with construction. Duke stated they would fully adhere to NRC, OSHA, and State safety standards, practices, and procedures during any activities related to site preparation/excavation or building the proposed facility (Duke 2009c).

Other nonradiological health impacts on workers who are clearing land or building the facility discussed in this section include noise, fugitive dust, and gaseous emissions resulting from site-preparation and development activities. Mitigation measures discussed in this section for workers, such as operational controls and practices, would also help limit exposure to the public. Specifically, diesel exhaust is a potential human carcinogen. Measures to reduce worker exposure to diesel exhaust include retrofitting engines with an EPA-certified exhaust filtration device; positioning exhaust pipes away from workers; ensuring engines are fitted with catalytic converters; ensuring proper ventilation when operating diesel-fueled equipment indoors; using enclosed, climate-controlled and pressured cabs equipped with high-efficiency particulate air filters; regularly maintaining diesel engines; and turning diesel engines off when not in use for more than a few minutes (EPA 2012). Onsite impacts on workers also would be mitigated through training and use of personal protective equipment to minimize the risk of potentially harmful exposures (Duke 2009c). Emergency first-aid care and regular health and safety monitoring of personnel also could be undertaken. Based on the mitigation measures identified by Duke in its ER, the permits and authorizations required by State and local agencies, and the review team's own independent review, the review team concludes that the nonradiological health impacts on construction worker health from site-preparation and building activities would be negligible and that additional mitigation beyond the actions identified above would not be warranted.

4.8.2 Noise Impacts

Development of a nuclear power plant is similar to other large industrial projects—it involves many noise-generating activities. Regulations governing noise from site-preparation and building activities are generally limited to worker health. Federal regulations governing construction noise are found in 29 CFR Part 1910 and 40 CFR Part 204. The regulations in 29 CFR Part 1910 govern noise exposure in the construction environment, and the regulations in 40 CFR Part 204 generally govern the noise levels of compressors. Neither South Carolina nor Cherokee County has specific noise regulations; however, Duke stated that all workers would be trained in compliance with regulations outlined in the Noise Control Act of 1972 (42 U.S.C. 4901 et seq.) (Duke 2009c).

Duke (2011b) stated the activities associated with building the proposed Lee Nuclear Station Units 1 and 2 would have peak noise levels in the range of 80 to 95 dBA at a distance of 50 ft from their source. A decrease of 10 dBA in noise level is generally perceived as cutting the loudness in half. At a distance of 100 ft from the source, these noise levels would generally decrease to the 74 to 89 dBA range, and at a distance of 400 ft the noise levels would generally be in the 62 to 77 dBA range (Duke 2011b). For context, Tipler (1982) lists the sound intensity of a quiet office as 50 dBA, normal conversation as 60 dBA, busy traffic as 70 dBA, and a noisy office with machines or an average factory as 80 dBA. Construction noise (at 10 ft) is listed as 110 dBA, and the pain threshold is 120 dBA.

The nearest residence to the Lee Nuclear Station site is approximately 4077 ft from most building activities for the new units (Duke 2011b). A 100 dBA noise level at 50 ft from an activity would be expected to decrease to less than 70 dBA at the exclusionary boundary along the Broad River (Duke 2011b). Similarly, a 100 dBA noise level would be expected to decrease to less than 60 dBA at the nearest residence (Duke 2011b). These estimates are conservative because they do not include the increase of noise attenuation attributed to vegetation and topography at the Lee Nuclear Station site.

There are no major roads, public buildings, or residences within the exclusion area; however, there are four family cemeteries located within the exclusionary boundary, one of which is within 2000 ft of the proposed building site and it may be affected by noise from site preparation and development (Duke 2009c). Recreation activities such as fishing and boating on the Broad River may also be affected by noise during building (Duke 2009c). Building activities would be expected to take place between 0700 and 1700 hours, but there will be occasions when activities will take place during nighttime hours (Duke 2009c).

According to the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NRC 1996), noise levels below 60 to 65 dBA are considered to be of small significance. More recently, the impacts of noise were considered in Supplement 1, *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors* (NRC 2002). The criterion for assessing the level of significance was not expressed in terms of sound levels but based on the effect of noise on human activities and on threatened and endangered species. The criterion in NUREG-0586, Supplement 1, is stated as follows:

> The noise impacts...are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts...are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened and endangered species is affected.

Considering the anticipated low noise levels at sensitive receptor locations, the implementation of OSHA-required procedures to protect worker health, the temporary nature of construction activities, compliance with Noise Control Act regulations, and the location and site characteristics of the Lee Nuclear Station site, the review team concludes that the noise impacts from construction and preconstruction would be minimal and that additional mitigation beyond the actions identified above would not be warranted.

4.8.3 Impacts of Transporting Construction Materials and Construction Personnel to the Lee Nuclear Station Site

This EIS assesses the impact of transporting workers and construction materials to and from the Lee Nuclear Station site and alternative sites from the perspective of three areas of impact: the socioeconomic impacts, the air-quality impacts of dust and emissions from vehicle traffic, and the potential health impacts due to additional traffic-related accidents. The human health impacts are addressed in this section, while the socioeconomic impacts are addressed in Section 4.4.1.3, and the air-quality impacts are addressed in Section 4.7.2.

The general approach used to calculate nonradiological impacts of fuel and waste shipments is the same as that used for transportation of construction materials and construction personnel to and from the Lee Nuclear Station site. However, preliminary estimates are the only data available to estimate the demand for these transportation services. The assumptions made to fill in reasonable estimates of the data needed to calculate nonradiological impacts are discussed below.

Construction material requirements are based on information provided in the ER (Duke 2009c). Duke estimated that building each new AP1000 reactor requires up to 460,000 yd^3 of concrete, 71,000 T of structural steel and rebar, 1,420,000 linear ft of cable, and 69,000 linear ft of piping. These quantities would be doubled to account for a two-unit plant. In addition, the materials and workers required to construct Make-Up Pond C are also added as part of the preconstruction impacts. For the Make-Up Pond C development, the required materials are approximately as follows:

- 160,000 yd^3 of crushed stone for roads and laydown areas
- 250,000 yd^3 of crushed stone/riprap for dams
- 100,000 yd^3 of soil material for saddle dikes
- 50,000 yd^3 of concrete
- 4000 tons of rebar
- 200 miscellaneous semi-truck/trailer deliveries
- 2000 tons of precast concrete for Highway 329 bridge
- 5000 tons of asphalt paving
- 113,000 linear ft of piping
- 4000 linear ft of cabling.

Development of proposed Make-Up Pond C and its associated facilities is expected to require a maximum of 185 workers.

Construction Impacts at the Lee Nuclear Station Site

Additional information needed to develop the nonradiological impact estimates is as follows:

- It was assumed that shipment capacities are 10 m^3 (approximately 13 yd^3) of concrete per shipment, 10 MT (11 T) of structural steel, and 300 linear meters (1000 linear ft) of piping and cable per shipment. It was assumed that these materials would be transported to the site in a levelized manner over a 91-month period based on the schedule given in the ER (Duke 2009c).
- The number of construction workers was estimated to peak at 4613 (Duke 2009c). This value represents the peak workforce for construction of both units. This peak construction workforce for both units is conservatively used to estimate impacts for a single unit. Assuming 1.0 persons/vehicle, there would be about 4613 vehicles per day per unit. Each person was assumed to travel to and from the Lee Nuclear Station site 250 d/yr.
- Average shipping distances for construction materials were assumed to be 80 km (50 mi) one way. The average commute distance for construction workers was assumed to be 32 km (20 mi) one way.
- Accident, injury, and fatality rates during transportation of construction materials were taken from Table 4 in ANL/ESD/TM-150 *State-level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999). Rates for South Carolina were used for construction material shipments, typically transported in heavy, combination trucks. The data in Saricks and Tompkins (1999) are representative of heavy truck accident rates and do not specifically address the impacts associated with commuter traffic (i.e., workers traveling to and from the site). However, a single source that provided all three rates to estimate the impacts from worker transportation to and from the site was not available. To develop representative commuter traffic impacts, a source was located that provided a South Carolina-specific fatality rate for all traffic for the years 2003 to 2007 (DOT 2009). The average fatality rate for this period in South Carolina was used as the base for estimating South Carolina-specific injury and accident rates. Adjustment factors were developed using national level traffic accident statistics in *National Transportation Statistics 2007* (DOT 2007). The adjustment factors are the ratio of the national injury rate to the national fatality rate and the ratio of the national accident rate to the national fatality rate. These adjustment factors were multiplied by the South Carolina-specific fatality rate to approximate the injury and accident rates for commuters in South Carolina.
- The Department of Transportation Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins (1999) rates, which were taken from the Motor Carrier Management Information System, and determined that the rates were under-reported. Therefore, the accident, injury, and fatality rates in Saricks and Tompkins (1999) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (UMTRI) (2003). The UMTRI data indicate that accident rates for 1994 to 1996, the same data used by Saricks and Tompkins (1999), were under-reported by about 39 percent. Injury and fatality rates were under-reported by 16 and

36 percent, respectively. As a result, the accident, injury, and fatality rates were increased by factors of 1.64, 1.20, and 1.57, respectively, to account for the under-reporting. These adjustments were applied to the construction materials transported by heavy truck shipments similar to those evaluated by Saricks and Tompkins (1999) but not to commuter traffic accidents.

The estimated nonradiological impacts of transporting construction materials to the Lee Nuclear Station site and of transporting construction workers to and from the site are shown in Table 4-5. The worker commuter estimates are conservatively calculated for one unit based on peak construction workers for the construction of both units. The impacts for materials and transporting construction workers would be approximately doubled for construction of two units at the Lee Nuclear Station site. The units would be built on a staggered schedule; therefore, the peak construction worker demands for the two units occur in different years. As discussed above, the peak construction workforce is 4613 workers, so the peak nonradiological impact estimates would be slightly lower than double the estimates given in Table 4-4. Note the nonradiological impacts are dominated by transport of construction workers to and from the Lee Nuclear Station site; that is, the nonradiological impacts of transporting construction materials to the site are a small fraction of the impacts of transporting construction workers. The total annual construction fatalities represent about a 2 percent increase above the 45 traffic fatalities that occurred in Cherokee and York Counties in 2007 (DOT 2009). This represents a small increase relative to the current traffic fatality risks in the area surrounding the Lee Nuclear Station site.

The review team concludes that the impacts of transporting construction materials and personnel to the Lee Nuclear Station site would be minimal, and no mitigation would be warranted.

Table 4-5. Annual Nonradiological Impacts of Transporting Workers and Construction Materials to/from the Lee Nuclear Station Site for a Single AP1000 Reactor

	Accidents per Year Per Unit	**Injuries per Year Per Unit**	**Fatalities per Year Per Unit**
Workers	$1.50 \times 10^{+2}$	$6.6 \times 10^{+1}$	1.0×10^{0}
Materials			
Concrete	$2.2 \times 10^{+0}$	9.1×10^{-1}	1.2×10^{-1}
Rebar, structural steel	2.0×10^{-1}	8.3×10^{-2}	1.1×10^{-2}
Cable	1.2×10^{-2}	4.8×10^{-3}	6.4×10^{-4}
Piping	1.6×10^{-3}	6.5×10^{-4}	8.7×10^{-5}
Total – Construction	1.5×10^{2}	6.7×10^{1}	1.1×10^{0}

The impacts in Table 4-5 can be divided into preconstruction and construction impacts using data provided by Duke (2009c). Duke estimated that 60 percent of the traffic impacts would occur during preconstruction activities (essentially site preparation and building of non-safety-related structures, including Make-Up Pond C, transmission line, and the railroad spur) and the remainder during construction of safety-related structures. These ratios are applied to the total nonradiological impacts of transporting workers and materials to the site over the preconstruction and construction phases. The total impacts were estimated by the review team by multiplying the annual impacts in Table 4-5 by the equivalent number of years of peak construction activities at the site. For workers, this is equivalent to 3.8 years at the peak building worker demand (4163 workers), assuming a levelized annual increase from zero workers at the start of building activities to 4163 workers after 2 years and then back to zero workers after 6 years. This totals 17,500 worker-years. For materials, it was assumed the materials would be delivered to the site in a levelized manner over 6 years; thus, the materials impacts in Table 4-5 were multiplied by 6 years to obtain the total impacts. The accidents, injuries, and fatalities were then multiplied by the preceding ratios to separate the preconstruction phase impacts from the construction phase impacts. The results are presented in Table 4-6.

Table 4-6. Nonradiological Impacts during Preconstruction and Construction Activities at the Lee Nuclear Station for a Single AP1000

	Total Impacts		
	Total Accidents	Total Injuries	Total Fatalities
Total Impacts, Preconstruction Plus Construction			
Workers	5.5×10^2	2.5×10^2	3.8×10^0
Materials	1.4×10^1	6.0	8.1×10^{-1}
Total	5.7×10^2	2.5×10^2	4.7
Preconstruction[(a)]			
Workers	3.5×10^2	1.6×10^2	2.4
Materials	1.6×10^1	6.5	8.7×10^{-1}
Total	3.6×10^2	1.6×10^1	3.3
Construction[(a)]			
Workers	2.2×10^2	9.9×10^1	1.5×10^0
Materials	5.8	2.4	3.2×10^{-1}
Total	2.3×10^2	1.0×10^2	1.9×10^0

(a) The separation between preconstruction and construction traffic impacts was estimated by Duke (2009c) at 60 percent preconstruction and 40 percent construction. These percentages were applied to both worker and construction material impacts.

4.8.4 Summary of Nonradiological Health Impacts

As part of its evaluation of nonradiological health impacts, the review team considered the mitigation measures identified by Duke in its ER and relevant permits and authorizations required by State and local agencies for building Units 1 and 2. The team evaluated nonradiological impacts on public and construction worker health from fugitive dust, occupational injuries, noise, and transport of materials and personnel to and from the Lee Nuclear Station site. No significant impacts related to the nonradiological health of the public or workers were identified during the course of this review. Based on information provided by Duke and the review team’s independent evaluation, the review team concludes that the nonradiological health impacts of construction and preconstruction activities associated with the proposed Units 1 and 2 would be SMALL, and no further mitigation would be warranted. Based on the above analysis, and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC concludes that the nonradiological health impacts of NRC-authorized construction activities would be SMALL; the NRC staff also concludes that no mitigation, beyond the applicant’s commitments, would be warranted.

4.9 Radiological Health Impacts

Because no nuclear fuel or radioactive waste would be onsite, construction workers on proposed Lee Nuclear Station Unit 1 would receive no radiation exposure above natural background radiation, which is currently estimated to average about 311 mrem/yr to the U.S. population (NCRP 2009).

After fuel for proposed Unit 1 is moved onsite and the reactor is fueled and put into operation, the potential sources of radiation exposure for construction workers on proposed Unit 2 would include direct radiation exposure, exposure from liquid effluents, and exposure from gaseous radioactive effluents from operation of proposed Unit 1. For the purposes of this discussion, construction and site preparation workers are assumed to be members of the public. Therefore, the dose estimates were compared to the dose limits for the public, pursuant to 10 CFR Part 20, Subpart D.

4.9.1 Direct Radiation Exposures

In its ER (Duke 2009c), Duke identified the proposed Unit 1 as a potential source of direct radiation exposure to proposed Unit 2 construction workers. The staff did not identify any additional sources of direct radiation during the site audit or during document reviews.

Because no operating reactors or radioactive materials are currently onsite, Duke based its direct radiation exposure characterization on Revision 19 of the Design Control Document (DCD) for the AP1000 reactor (Duke 2013a). Sources of direct radiation (i.e., refueling water storage tank) would be inside shielded buildings; therefore, the DCD characterized direct radiation from the containment building and other facility buildings as negligible (Westinghouse 2011). Based on the DCD characterization, Duke estimated direct radiation exposure to construction workers would be negligible (Duke 2013a).

In addition, at certain times during construction, Duke would receive, possess, and use specific radioactive byproduct, source, and special nuclear material in support of construction and preparations for operation. These sources of low-level radiation are required to be controlled by the applicant's radiation protection program, provided with physical protection when required, and have very specific uses under controlled conditions. Therefore, these sources are expected to result in a negligible contribution to construction worker doses.

4.9.2 Radiation Exposures from Gaseous Effluents

When operating, proposed Lee Nuclear Station Unit 1 would release gaseous effluents via the plant vent or the turbine building vent that could affect construction workers on Unit 2. Containment venting releases, auxiliary building ventilation releases, annex building releases, radwaste building releases, and the gaseous radioactive waste system would discharge via the plant vent. The condenser air removal system, gland seal condenser exhaust, and the turbine building ventilation would be released via the turbine building vent (Duke 2009c). Duke estimated construction worker dose from gaseous effluents based on gaseous release data from Revision 19 of the DCD (Duke 2013a). Two years of site-specific meteorological data (Duke 2013a) and the computer code XOQDOQ (Sagendorf et al. 1982) were used to predict annual average atmospheric dispersion and deposition values at various receptor locations. The gaseous release data and atmospheric dispersion values were input to the GASPAR II computer code (Strenge et al. 1987) to compute dose rates for the nearest location along the proposed Unit 1 protected area fence in each direction as well as for the nearest point of the Unit 2 shield building construction area (i.e., the principal construction area) (Duke 2013a). The annual dose to a construction worker at the principal construction area from gaseous effluents was estimated to be approximately 0.4 mrem (based on an occupancy of 2080 hr/yr) (Duke 2013a).

4.9.3 Radiation Exposures from Liquid Effluents

Duke estimated that radiation exposures from liquid effluents would not contribute to the proposed Unit 2 construction worker dose. Work performed after Unit 1 becomes operational, such as the tie-in of proposed Unit 2 liquid effluent piping into the discharge structure and blowdown piping of proposed Unit 1, would be completed by Unit 1 personnel under the Unit 1 radiation protection program (Duke 2013a).

4.9.4 Total Dose to Site-Preparation Workers

Duke (2013a) estimated the annual dose to a Unit 2 construction worker to be approximately 0.4 mrem assuming an occupancy of 2080 hr/yr. This estimated annual worker dose is entirely from the gaseous radiation pathway with negligible dose contributions from the other pathways. This dose is less than the 100-mrem annual dose limit to an individual member of the public found in 10 CFR 20.1301.

The maximum estimated annual collective dose to construction workers, based on an annual individual dose of approximately 0.4 mrem and an estimated workforce of 2100 workers, is approximately 0.83 person-rem. The maximum annual dose to a construction worker is much smaller than the approximately 311 mrem/yr that residents of the United States receive on average from background radiation (NCRP 2009).

4.9.5 Summary of Radiological Health Impacts

The NRC staff concludes that the estimate of doses to construction workers during building of the proposed Units 1 and 2 are well within NRC annual exposure limits (i.e., 100 mrem) designed to protect the public health. Based on information provided by Duke and the NRC staff's independent evaluation, the NRC staff concludes that the radiological health impacts on construction workers engaged in building activities related to the proposed Units 1 and 2 would be SMALL, and no further mitigation would be warranted. The NRC regulates radiation exposure from all NRC-licensed activities. Therefore, the NRC staff concludes the radiological health impacts for NRC-authorized construction of proposed Lee Nuclear Station Units 1 and 2 would be SMALL, and no further mitigation would be warranted.

4.10 Nonradioactive Waste Impacts

The following sections provide descriptions of the potential environmental impacts from the generation, handling, and/or disposal of nonradiological waste during building activities for the proposed Lee Nuclear Station. Potential types of nonradioactive wastes include construction debris, dredged spoils, stormwater runoff, municipal and sanitary waste, dust, and air emissions. The assessment of potential impacts resulting from these types of wastes is presented in the following sections.

4.10.1 Impacts on Land

Building activities related to proposed Lee Nuclear Station Units 1 and 2 would result in solid waste materials such as construction debris from excavation, land clearing, and dredge spoils. Construction debris from excavation and land clearing would be removed from the site via road or rail and disposed of at a licensed offsite facility (Duke 2009c). Duke may consider recycling woody debris from clearing activities for beneficial uses (e.g., using wood chips for mulch in landscaped areas of the site) (Duke 2009c).

Spoils generated from dredging the Broad River and Make-Up Ponds A and B for building activities associated with the intake and discharge structures for the new units would be placed in a 10.2-ac upland spoils area at the south end of the Lee Nuclear Station site near

McKowns Mountain Road (Duke 2009c). To reduce the amount of dredged spoils, they would be reused at the Lee Nuclear Station site whenever possible (Duke 2009c). The Department of the Army permit covering dredging during the building of proposed Lee Nuclear Station Units 1 and 2 would stipulate procedures to properly dispose of dredged spoils. Duke stated it would dispose of all waste generated by site-preparation and development activities for the Lee Nuclear Station site in accordance with applicable regulations, including the Resource Conservation and Recovery Act (RCRA) (Duke 2009c).

Based on Duke's stated commitment to manage solid wastes in accordance with all applicable Federal, State, and local requirements and standards, minimizing waste practices, and recycling when possible, the review team expects the impacts on land from nonradioactive wastes generated during the building of proposed Lee Nuclear Station Units 1 and 2 would be minimal, and no further mitigation would be warranted.

4.10.2 Impacts on Water

Building activities have the potential to affect surface water and groundwater on the Lee Nuclear Station site. Duke would obtain an NPDES General Permit for Stormwater Discharges from Large and Small Construction Activities to minimize potential impacts on surface water and groundwater during building activities. The SCDHEC would administer and enforce the NPDES general permit. As part of the permit, a SWPPP would be required, which would contain an erosion and sediment-control plan. Dewatering of the excavation site would be necessary during the site-preparation phase for Units 1 and 2, and that water would be discharged to the Broad River in accordance with the NPDES general permit (Duke 2009c). All dredging and other ground-disturbing activities near streams or waterbodies would implement BMPs associated with the site-specific SWPPP and comply with the NPDES permit requirements (Duke 2009c). Water-use impacts and water-quality impacts during the development of proposed Lee Nuclear Station Units 1 and 2 are further discussed in Section 4.2.

Onsite sanitary wastes generated during the building activities would be accommodated with a permanent sanitary drainage system (SDS), which would be installed and placed into service during site development, and would discharge offsite for processing at the Gaffney Board of Public Works' Broad River Waste Water Treatment Plant (Duke 2009c). The SDS would remain after building activities cease and would be used in the operation of proposed Lee Nuclear Station Units 1 and 2.

Duke consulted with the Gaffney Board of Public Works regarding the need for additional sanitary sewer service capacity (Duke 2010h). The Gaffney Board of Public Works stated that the Broad River Waste Water Treatment Plant has the capacity to handle the influx of wastewater from proposed Lee Nuclear Station Units 1 and 2 (Duke 2010h).

Based on regulated practices for managing liquid discharges including wastewater, the SCDHEC-issued NPDES permit and associated approved SWPPP, and Duke's plans to implement BMPs for managing building impacts on surface water and groundwater, the review team expects that impacts on water from nonradioactive effluents from building proposed Lee Nuclear Station Units 1 and 2 would be minimal, and no further mitigation would be warranted.

4.10.3 Impacts on Air

As discussed in Sections 4.4.1, 4.5.2, and 4.8.1, fugitive dust and other generated emissions during site-development activities would be managed by Duke according to a dust-control plan or similar document (Duke 2009c). Possible mitigation measures described in the dust-control plan would include stabilizing construction roads and spoils piles, limiting speed on unpaved roads, covering haul trucks, and watering unpaved construction roads (Duke 2009c). Equipment and vehicles used for site preparation and the increase in vehicle traffic of workers involved in building proposed Lee Nuclear Station Units 1 and 2 would result in increased gaseous and particulate emissions. Possible mitigation measures that would be used to limit these emissions include phased construction and performance maintenance on construction vehicles and equipment (Duke 2009c).

Based on the regulated practices for managing air emissions from construction equipment and temporary stationary sources, the review team expects that impacts on air from nonradioactive emissions during the building of proposed Lee Nuclear Station Units 1 and 2 would be minimal, and no further mitigation would be warranted.

4.10.4 Summary of Nonradioactive Waste Impacts

Solid, liquid, and gaseous wastes generated during the building of proposed Lee Nuclear Station Units 1 and 2 would be handled according to county, State, and Federal regulations. County and State permits and regulations for handling and disposal of solid waste and USACE permits for disposal of dredged spoils would be obtained and implemented. An NPDES permit with a SWPPP for surface-water runoff and groundwater quality, and the use of permanent facilities for sanitary-waste systems during the building period would ensure compliance with the CWA and the State of South Carolina standards. Based on this information provided by Duke and the review team’s independent evaluation, the review team concludes that nonradiological waste impacts on land, water, and air during construction and preconstruction activities would be SMALL and that additional mitigation would not be warranted. Based on the above analysis and because NRC-authorized construction activities represent only a portion of the analyzed activities, the NRC staff concludes that the nonradioactive waste impacts of NRC-authorized construction activities would be SMALL and that no further mitigation would be warranted. In its draft EIS comment letter dated March 6, 2012, the EPA recommended that the applicant incorporate sustainable or “green” building practices into non-safety-related areas of plant development, as practicable. Suggestions included using permeable pavement, re-planting construction laydown areas with native vegetation, and considering using environmentally friendly (e.g., recycled) materials for non-safety-related buildings and infrastructure (EPA 2012).

Cumulative impacts on water and air from nonradioactive effluents and emissions are discussed in Sections 7.2 and 7.6, respectively. For the purposes of Chapter 9, the review team expects that there would be no substantive differences between the impacts of nonradioactive waste for Lee Nuclear Station site and the alternative sites, and no substantive cumulative impacts that warrant further discussion beyond those discussed for the alternative sites in Section 9.3.

4.11 Measures and Controls to Limit Adverse Impacts During Construction

In its evaluation of environmental impacts during building activities for the proposed Lee Nuclear Station Units 1 and 2, the review team relied on Duke's stated intention to comply with the following measures and controls that would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts
- compliance with applicable requirements of Federal and State permits or licenses required for building the new units
- implementation of BMPs and good construction practices to limit potential impacts
- incorporation of environmental protection requirements into construction contracts.

The review team considered these measures and controls in its evaluation of the impacts of building proposed Lee Nuclear Station Units 1 and 2. Table 4-7 summarizes the measures and controls to limit adverse impacts when building proposed Units 1 and 2 based on Table 4.6-1 in the ER (Duke 2009b) and other information provided by the applicant. Some measures apply to more than one impact category.

Table 4-7. Measures and Controls to Limit Adverse Impacts when Building Proposed Lee Nuclear Station Units 1 and 2

Impact Category	Specific Measures and Controls
Land-use impacts	
Site and vicinity, including Make-Up Pond C	Limit ground disturbances to the smallest amount of area necessary to construct and maintain the proposed facilities.
	Minimize work in wetlands, floodplains, and prime farmlands to the extent possible.
	Perform ground-disturbing activities in accordance with SCDHEC stormwater permit requirements. Use erosion-control and stabilization measures.
	Limit ground-disturbing activities such as vegetation removal to the area designated for preconstruction and construction activities.
	Minimize potential spills of hazardous wastes/materials through training and rigorous compliance with applicable regulations.

Table 4-7. (contd)

Impact Category	Specific Measures and Controls
	Restrict soil stockpiling and reuse to designated areas on the Lee Nuclear Station site.
	Restore temporarily disturbed areas to allow for other land uses.
Transmission-line corridors and offsite areas	Site new corridors to avoid critical or sensitive habitat or species and to minimize work in wetlands, floodplains, and prime farmlands.
	Limit ground-disturbing activities such as vegetation removal to defined corridors and areas within those corridors to avoid nesting activities to the extent possible.
	Minimize potential impacts via avoidance and compliance with permitting requirements and BMPs.
	To the extent possible, avoid disturbing established crops while building the new transmission lines.
Water-related impacts	
Hydrologic alterations	Install rip rap, stemwalls, etc. to stabilize banks.
	Develop and implement a site-specific construction SWPPP and erosion-control plan.
	Conduct construction and dredging activities in compliance with USACE requirements, and SCDHEC and NPDES stormwater permits.
	Dispose of pond dredged material in an onsite spoils area.
	Place spoil material on top of railroad-spur embankment during construction of box culvert expansion at London Creek crossing.
	Use of small volume of flow from portion of London Creek above dam as compared to volume of Broad River at confluence.
Water-use impacts	Use BMPs, including cofferdams, to ensure dry conditions are necessary when building the dam and abutments for Make-Up Pond C.
	Groundwater levels will be lowered during construction; however, this effect will be local to the building site.
	Potable water will be obtained from a local municipality, and wastewater will be treated by a local municipality, and, therefore, onsite groundwater resources will not be affected.
Water-quality impacts	Install/construct cofferdams, settling basins, and/or use other standard engineering controls to protect affected waterbodies.
	Install a stormwater drainage system or settling basins at construction site and stabilize disturbed soils.
	Use BMPs during construction to minimize erosion and sedimentation.
	Use BMPs during construction to minimize the effects of discharging dewatering product to surface waterbodies.

Table 4-7. (contd)

Impact Category	Specific Measures and Controls
	Use BMPs to maintain equipment and prevent spills and leaks. Prepare and implement an SPCCP for site-development activities. Restrict activities using petroleum products and solvents to designated areas that are equipped with spill containment.
	Develop a SWPPP and erosion-control plans as required by the SCDHEC stormwater permit for construction practices.
	Develop a spill response plan for construction practices.
Ecological impacts	
Terrestrial and wetland ecosystems	Conduct land clearing according to Federal and State regulations, permit requirements, Duke's existing construction practices, and established BMPs.
	Conduct land clearing to minimize disturbance of vegetation and substrate.
	Phase building activities to minimize the duration of soil exposure and implement soil stabilization measures as quickly as possible after disturbance to minimize erosion and sedimentation.
	Obtain and comply with the Department of the Army permit and Clean Water Act Section 401 water-quality certification requirements to avoid, minimize, restore, and/or compensate impacts on wetlands, including development of a mitigation action plan.
	Water access roads and cleared areas to attenuate fugitive dust.
	Schedule vegetation clearing (including timber harvest) and grubbing, to the extent practicable, to avoid the migratory bird-nesting season.
	Locate equipment maintenance in an established yard away from wetlands and waterways.
	Site transmission towers such that wetlands and riparian areas are spanned by the conductors.
	Avoid environmentally sensitive areas as feasible (e.g., those with "important" habitats or species).
	Transplant, if practicable, Federal candidate and State-ranked plant species.
Aquatic ecosystems	Develop and implement a site-development SWPPP plan.
	Prepare and implement an SPCCP for site-development activities. Restrict activities using petroleum products and solvents to designated areas that are equipped with spill containment.
	Implement erosion and sediment-control plans that incorporate recognized BMPs.
	Install appropriate barriers and use BMPs to protect waterbodies and aquatic organisms prior to site-development activities.
	Obtain and comply with the Department of the Army permit, State 401 water-quality certification, and BMPs, including development of a mitigation action plan for wetland/stream impacts.

Table 4-7. (contd)

Impact Category	Specific Measures and Controls
	Screen pump inlets to avoid entraining fish and other large aquatic organisms during water diversion and dewatering activities.
Socioeconomic impacts	
Physical impacts	Implement construction contractual requirements to reduce the risk of potential exposure to noise, dust, and exhaust emissions.
	Stagger shifts, encourage carpooling, and schedule deliveries to mitigate shift change or commute times.
	Allow continued traffic flow during construction of new bridge and approaches for SC 329 alignment, then divert traffic to new alignment once complete.
	Perform construction activities in accordance with U.S. OSHA and South Carolina OSHA requirements.
	Provide appropriate job training to construction workers.
	Use dust-control measures (e.g., watering, stabilizing disturbed areas, covering trucks).
	Post signs near construction entrances and exits to make the public aware of potentially high construction traffic areas.
	Develop a traffic control mitigation plan.
	Establish procedures to ensure that all waste is disposed of according to applicable regulations such as the RCRA.
	Minimize impacts on air quality by mulching non-merchantable timber versus burning.
Social and economic impacts	Temporarily house employees in hotels, rental properties, and park facilities.
	Increase revenues to offset additional school resources, police, and fire protection.
	Increase water production at local facilities not operating at full capacity.
	Use existing landfills.
	In case of future property acquisitions, offer relocation assistance after closing residences and the option of staying in home up to 18 months rent-free, in order to find a replacement residence.
Environmental justice impacts	No mitigation measures required beyond those identified above.

Table 4-7. (contd)

Impact Category	Specific Measures and Controls
Historic and cultural properties impacts	Conduct cultural resource surveys, including subsurface sampling and visual impact assessments prior to initiating proposed and future ground-disturbing activities to identify historic properties and cultural resources.
	Implement the Lee Nuclear Station site cultural resources management plan and MOA between Duke, the South Carolina SHPO, USACE, and Catawba Indian Nation, including procedures to address inadvertent discoveries of potential historic properties or cultural resources.
	Relocate the Service Family Cemetery from Make-Up Pond C in coordination with the South Carolina SHPO, according to State law, and in cooperation with descendants.
	Avoid direct physical impacts on sensitive cultural resource (i.e., 38CK172 – possible human burial) located in transmission-line corridor.
	Avoid direct physical impacts on known historic cemeteries within the boundaries of the Lee Nuclear Station site and maintain public access.
Nonradiological health impacts	Adhere to all OSHA and State safety standards, practices, and procedures during building activities; provide regular training for site workers and visitors.
	Implement a site-wide safety and medical program, including procedures for emergency first aid and regular health and safety monitoring.
	No further mitigation beyond what is discussed under Socioeconomic Impacts–Physical Impacts would be required.
Radiological health impacts	Maintain doses to construction workers below NRC public dose limits (10 CFR Part 20).
Nonradioactive waste impacts	Handle waste generated during building in accordance with local, State, and Federal requirements.
	Implement a waste-minimization plan, including beneficial reuse and recycling of building debris.
	Implement both an SWPPP as required by the State NPDES permit and a SPCCP to reduce impacts from site runoff and spills.
	Implement operational controls (BMPs) to minimize fugitive dust emissions; implement traffic plans to reduce emissions from vehicles; regularly maintain emissions-generating equipment and operate in accordance with State air-quality regulations.

Source: Adapted from Table 4.6-1 of Duke 2009b

4.12 Summary of Construction and Preconstruction Impacts

The impact levels determined by the review team in the previous sections are summarized in Table 4-8. The impact levels for NRC-authorized construction as evaluated in this chapter are denoted in the table as SMALL, MODERATE, or LARGE as a measure of their expected adverse environmental impacts, if any. Combined construction and preconstruction impact levels are similarly noted. Some impacts, such as the addition of tax revenue from Duke for the local economies, are likely to be beneficial impacts on the community.

Table 4-8. Summary of Impacts from Construction and Preconstruction of Proposed Lee Nuclear Station Units 1 and 2

Resource Category	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Land Use			
The site and vicinity	The project would make use of a site with a history of industrial land disturbance, that is large enough to accommodate the new facilities without substantial encroachment into environmentally sensitive areas, and that does not conflict with zoning or surrounding land uses. However, building Make-Up Pond C would require acquisition of approximately 2110 ac of previously undisturbed rural land and long-term termination of agricultural and other rural land uses thereon. Additional land would be affected by building about 31 mi of new transmission lines.	SMALL	MODERATE
Transmission-line corridors and other offsite areas	New transmission-line corridors would occupy approximately 987 ac of land. Other offsite land-use impacts would be limited.	SMALL	MODERATE
Water-Related			
Surface-water use	Construction and preconstruction impacts on surface water would be of limited duration, and peak water demands would represent a small portion of the available water.	SMALL	SMALL
Groundwater use	Construction and preconstruction impacts on groundwater use would be of limited magnitude, localized, and temporary.	SMALL	SMALL
Surface-water quality	Construction and preconstruction impacts on surface-water quality would be minimal and also localized and temporary.	SMALL	SMALL
Groundwater quality	Construction and preconstruction impacts on groundwater quality would be of limited magnitude, localized, and temporary.	SMALL	SMALL

Table 4-8. (contd)

Resource Category	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Ecology			
Terrestrial and wetland ecosystems	The loss of habitat due to preconstruction impacts within the immediate vicinity of Make-Up Pond C, especially the removal of mixed hardwood forest along London Creek and its tributaries, and within the transmission-line corridors, especially the removal of forest habitat, would noticeably alter but not destabilize terrestrial and wetland resources. The loss of habitat at Make-Up Pond C would permanently reduce wildlife populations in the London Creek watershed and reduce the functionality of the watershed as a wildlife travel corridor. The loss of upland habitat on the Lee Nuclear Station site would be spatially extensive, but about half of the loss would occur in previously disturbed, low-quality, early successional habitats. Temporary drawdown of Make-Up Ponds A and B during construction of intake/refill structures could temporarily alter the function of some marginal wetlands. Preconstruction impacts would be minor within the railroad-spur corridor and offsite road-improvement areas.	SMALL	MODERATE
Aquatic Ecosystems	The loss of aquatic biota and lotic habitat associated with preconstruction impacts within the immediate vicinity of Make-Up Pond C, mainly as a result of the impoundment of London Creek to create the supplemental cooling-water reservoir, would noticeably alter but not destabilize aquatic resources. Temporary drawdown of Make-Up Ponds A and B to minimize pressure on cofferdams during construction of intake/refill structures would temporarily alter benthic, littoral, and shoreline habitats. Other preconstruction impacts on aquatic resources would be minor at the Lee Nuclear Station site.	SMALL	MODERATE
Socioeconomics			
Physical impacts	Preconstruction physical impacts on aesthetics would occur; most of the impacts would be associated with development of the Make-Up Pond C site. Other physical impacts would not be noticeable.	SMALL	MODERATE
Demography	Construction and preconstruction demographic impacts on the communities nearest the Lee Nuclear Station site would be small and temporary.	SMALL	SMALL
Economic impacts on the community	Construction and preconstruction economic and tax revenue impacts on the communities nearest the Lee Nuclear Station would be minimal.	SMALL (beneficial)	SMALL (beneficial)

Table 4-8. (contd)

Resource Category	Comments	NRC-Authorized Construction Impact Level	Construction and Preconstruction Impact Level
Infrastructure and community services	Construction and preconstruction traffic impacts would be noticeable, particularly on McKowns Mountain Road near the Lee Nuclear Station site. Other infrastructure and community services impacts would not be noticeable.	MODERATE	MODERATE
Environmental Justice	There are no environmental, health, or socioeconomic pathways by which the identified minority or low-income populations in the 50-mi region would be likely to suffer disproportionately high and adverse impacts as a result of construction and preconstruction activities.	SMALL	SMALL
Historic and Cultural Resources			
The site and vicinity	Construction impacts on historic properties and cultural resources would be negligible with implementation of the Lee Nuclear Station site cultural resources management plan and MOA between Duke, the South Carolina SHPO, USACE, and Catawba Indian Nation. Preconstruction impacts on historic and cultural resources would be noticeable but not destabilizing within the Make-Up Pond C site with successful relocation of the Service Family Cemetery.	SMALL	MODERATE
Transmission-line corridors and other offsite areas	Construction impacts on historic properties and cultural resources would be negligible in the transmission-line and railroad-spur corridors with implementation of Duke Energy's corporate procedures to protect known historic and cultural resources, including avoidance of a possible human burial site (38CK172).	SMALL	SMALL
Air Quality	Construction and preconstruction impacts on air quality would be limited.	SMALL	SMALL
Nonradiological Health	Construction and preconstruction impacts on nonradiological human health would be minimal.	SMALL	SMALL
Radiological Health	Doses to construction workers would be maintained below NRC public dose limits (10 CFR Part 20).	SMALL	SMALL
Nonradioactive Waste	Impacts on land, water, and air would be minimal.	SMALL	SMALL

5.0 Operational Impacts at the Lee Nuclear Station Site

This chapter examines environmental issues associated with operation of proposed Units 1 and 2 at the William States Lee III Nuclear Station (Lee Nuclear Station). Duke Energy Carolinas, LLC (Duke) has applied for combined construction permits and operating licenses (COLs) for two units and submitted an environmental report (ER) that discussed the environmental impacts of station operation (Duke 2009b, c). In its evaluation of operational impacts, the review team, comprising members of the U.S. Nuclear Regulatory Commission (NRC) staff, its contractors, and the U.S. Army Corps of Engineers (USACE), relied on operational details supplied by Duke in its ER, Duke's responses to NRC Requests for Additional Information (RAIs), and the review team's own independent review. The review team also consulted permitting correspondence between Duke and the USACE, a cooperating agency, in this action.

This chapter is divided into 13 sections. Sections 5.1 through 5.11 discuss the potential operational impacts on land use, water, terrestrial and aquatic ecosystems, socioeconomics, environmental justice, historic and cultural resources, meteorology and air quality, nonradiological health, radiological health, nonradioactive waste, as well as postulated accidents. Section 5.12 discusses measures and controls that would limit the adverse impacts of station operation during the 40-year operating period. In accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 51, impacts have been analyzed and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned to each analysis. In the area of socioeconomics related to taxes, the impacts may be considered beneficial and are stated as such, as appropriate. The review team's determination of significance levels is based on the assumption that the mitigation measures identified in the ER or activities planned by various State and county governments, such as infrastructure upgrades discussed throughout this chapter, are implemented. Failure to implement these mitigation measures and upgrades might result in a change in significance level. Mitigation of adverse impacts, beyond what is stated in the Duke ER, is also presented where appropriate.
A summary of operational impacts is presented in Section 5.13.

5.1 Land-Use Impacts

Sections 5.1.1 and 5.1.2 contain information regarding land-use impacts associated with operation of proposed Lee Nuclear Station Units 1 and 2. Section 5.1.1 discusses land-use impacts at the site and in the vicinity of the site. Section 5.1.2 discusses land-use impacts with respect to transmission-line corridors and offsite areas. No part of the Lee Nuclear Station project is proposed for the coastal zone. As explained in Section 4.1, no zoning conflicts or conflicts with land use plans, policies, or controls are expected from the project.

5.1.1 The Site and Vicinity, Including the Make-Up Pond C Site

Duke stated that no additional land on the Lee Nuclear Station site or the Make-Up Pond C site would be disturbed during operations (Duke 2009b, c). As noted in Section 4.1, there are no known zoning conflicts expected for the Lee Nuclear Station project. Duke has also stated that no part of the Lee Nuclear Station site would be used for agriculture during operations (Duke 2009b, c), including the 2 ac of prime farmland onsite. However, the soil properties of that prime farmland would remain undisturbed. The review team expects that no lands on the Make-Up Pond C site would be available for agricultural use, including any remaining areas of undisturbed prime farmland or farmland of statewide importance. Duke has not indicated whether any of the subject lands might one day be managed for forestry. However, the review team expects that limited forest management might be possible on undeveloped lands remaining on the Lee Nuclear Station site or lands owned by Duke around Make-Up Pond C.

Duke has not specifically stated in its application whether it might allow mining or extractive uses of undeveloped lands on the Lee Nuclear Station or Make-Up Pond C sites during operations. However, based on Duke's statements that no additional land on either property would be disturbed after construction (Duke 2009b, c), the review team expects that such uses would not be conducted during operation of the proposed units. The review team does not expect that operation of the proposed Duke facilities would interfere with the active sand mining operation situated approximately 1 mi upstream of the Lee Nuclear Station site or with other extractive operations that might be conducted in the vicinity in the future.

No additional land within the vicinity is expected to be disturbed directly by the operation of the Lee Nuclear Station; however, some offsite indirect land-use changes might result from the need to support plant maintenance and operation workers. Such indirect land-use changes might include conversion of some land, most likely land near the city of Gaffney and along various transportation corridors near the site, to housing developments such as apartment buildings, single-family condominiums and homes, and manufactured home parks.

The expansion of supporting services, such as light commercial and retail development providing services to Lee Nuclear Station workers, may also be expected in the surrounding vicinity. Property tax revenue from the operation of two nuclear units could also indirectly lead to additional growth and land conversion in Cherokee County (less so in York County) because of infrastructure improvements (e.g., upgraded roads and utility services). Additional information regarding operational-related socioeconomic and infrastructure impacts within the vicinity of the Lee Nuclear Station site can be found in Section 5.4.

Proposed Lee Nuclear Station Units 1 and 2 would use evaporative closed cooling systems. However, salt drift is not expected to affect land use outside of the Lee Nuclear Station site. NUREG-1555 (NRC 2000a) suggests that leaf damage is unlikely when salt deposition is less than 1 to 2 kg/ha/mo. The maximum predicted salt deposition rate from operation of proposed

Units 1 and 2 is 0.0103 kg/ha/mo, approximately 200 m north of the cooling towers in the summer, which is well below the suggested threshold value of 1 to 2 kg/ha/mo for possible adverse effects to vegetation, and by extension, the terrestrial environment (Section 5.3.1). This value is considered peak deposition and is expected to be lower in all directions from the cooling tower during each season and annually (Duke 2013a).

Make-Up Pond C would have minimal land-use impacts during operations. However, public access to the pond would be restricted by a fence. The pond would not be available for public recreational use. Duke expects to conduct maintenance associated with pipeline corridors. Maintenance activities for the pipeline may occasionally temporarily close part of Rolling Mill Road (Duke 2010h).

Based on information provided by Duke and the review team's independent review, the review team concludes that operation of Lee Nuclear Station Units 1 and 2 would have a SMALL land-use impact and mitigation would not be warranted.

5.1.2 Transmission-Line Corridors and Offsite Areas

As discussed in Section 4.1.3, approximately 690 ac of forest on the proposed transmission-line corridors would be permanently cleared. Easements are expected to restrict the placement of permanent structures or tree plantings that may interfere with line maintenance. However, Duke would allow farming and crop production within the transmission corridors. Routine or seasonal transmission-line maintenance would take place outside of crop production time frames, limiting impacts to crops. Most of the approximately 163 ac of prime farmland or farmland of statewide importance within the proposed transmission-line corridor could remain in agricultural production, although small amounts of farmland could be removed from agricultural use to place the transmission towers. Allowable uses in the cleared corridors might include pasture, crop production, road construction, parking lots, and other uses that do not interfere with the safe, reliable operation of the transmission lines.

Duke would be responsible for conducting, and expects to conduct, routine maintenance associated with the reliability and safety of the new corridors. These activities include, but are not limited to, inspections, clearing of vegetation in the corridors as needed, repair and replacement of equipment, and any necessary activities regarding the maintenance of lines in the existing Pacolet-Catawba and Oconee-Newport corridors.

Duke anticipates no additional restrictions in the transmission-line corridors. Therefore, the review team concludes that the land-use impacts of operation would be SMALL and additional mitigation would not be warranted.

5.1.3 Summary of Land-Use Impacts during Operations

The review team evaluated the potential land-use impacts from operation of proposed Lee Nuclear Station Units 1 and 2. Based on information provided by Duke in its ER (Duke 2009c), the supplement to the ER (Duke 2009b), other information provided by Duke, and the review team's independent evaluation, the review team concludes land-use impacts from operating proposed Lee Nuclear Station Units 1 and 2 would be SMALL, and additional mitigation would not be warranted.

5.2 Water-Related Impacts

This section discusses water-related impacts to the environment from operation of the proposed Lee Nuclear Station Units 1 and 2.

Managing water resources requires understanding and balancing the tradeoffs between various, often conflicting, objectives. At the Lee Nuclear Station site, these objectives include recreation, visual aesthetics, a fishery, and a variety of beneficial consumptive domestic, farming, and industrial uses of water.

Water-use and water-quality impacts involved with operation of a nuclear plant are similar to the impacts associated with any large thermoelectric power generation facility. Accordingly, Duke must obtain the same water-related permits and certifications as any other large industrial facility. These would include:

- Clean Water Act (CWA) Section 401 Certification. This certification would be issued by the South Carolina Department of Health and Environmental Control (SCDHEC) and would confirm that operation of the plant would not conflict with State water-quality-management programs.
- CWA Section 402(p) National Pollutant Discharge Elimination System (NPDES) Discharge Permit. This permit (Permit No. SC0049140) was issued by the SCDHEC on July 17, 2013, effective September 1, 2013, and regulates limits of pollutants in liquid discharges to surface water.
- CWA Section 316(a). This section regulates the cooling-water discharges to protect the health of the aquatic environment. The scope is covered under the NPDES permit issued to Duke by SCDHEC.
- CWA Section 316(b). This section regulates cooling-water intake structures to minimize environmental impacts associated with location, design, construction, and capacity of those structures. The scope is covered under the NPDES permit issued to Duke by SCDHEC.

- South Carolina Surface Water Withdrawal, Permitting, Use, and Reporting Act (SC Code Ann. 49-4). This act provides for the permitting of surface-water withdrawals greater than 3 million gallons per month.
- Federal Power Act Sections 4(e) and 15. This act requires a license from the Federal Energy Regulatory Commission (FERC) for operation and maintenance of 18-MW Ninety-Nine Islands Hydroelectric Project No 2331.

The responsibility for regulating water quality pursuant to the CWA is delegated by the U.S. Environmental Protection Agency (EPA) to the SCDHEC. On August 11, 2011, Duke submitted an application for an NPDES permit for the proposed Lee Nuclear Station to the SCDHEC (Duke 2011a). The SCDHEC issued NPDES permit SC0049140 to Duke on July 17, 2013 (SCDHEC 2013a).

Details of the operational modes and cooling-water systems associated with operation of the plant can be found in Section 3.4.1 of this environmental impact statement (EIS). A description of the Lee Nuclear Station site's operational hydrological alterations was presented in Section 5.3 of the ER (Duke 2009c).

This section discusses the review team's independent assessment of the impacts of operating proposed Lee Nuclear Station Units 1 and 2 on the affected water resources. The expected hydrologic alterations in surface water and groundwater related to operation of proposed Lee Nuclear Station Units 1 and 2 are discussed in Section 5.2.1. Water-use impacts are discussed in Section 5.2.2 for surface water (5.2.2.1) and groundwater (5.2.2.2). Water-quality impacts are discussed in Section 5.2.3 for surface water (5.2.3.1) and groundwater (5.2.3.2). Water monitoring is discussed in Section 5.2.4 for surface water (5.2.4.1) and groundwater (5.2.4.2).

5.2.1 Hydrological Alterations

The water withdrawals from and discharges to the Broad River from the proposed Lee Nuclear Station Units 1 and 2 are described in Section 3.4.2.1. As described in Section 2.3.1, streamflow in the Broad River was characterized using three different data sets: Duke's 85-year synthetic gap-filled streamflow record, the review team's independently developed long-term gap-filled streamflow record, and the short-term record for the U.S. Geological Survey (USGS) gaging station just downstream of Ninety-Nine Islands Dam. Duke's estimate of the mean annual flow (2495 cfs), the review team's independent estimate (2485 cfs), and the USGS gage (1858 cfs) are not inconsistent. The lower value for the USGS gage reflects the bias caused by a short period of record (2000 through 2010) in which several severe droughts occurred. Based on its flow record, Duke reported a similar value (1956 cfs) as the mean annual flow for the 2001 to 2010 period.

The review team performed an independent confirmatory water budget assessment due to the importance of the water budget outcomes in determining the need for the construction of

Make-Up Pond C, which results in impacts other than SMALL in several resource areas. The review team assessed Duke's proposal for water withdrawal and discharge to the Broad River during operation of the proposed Lee Nuclear Station Units 1 and 2, as well as the projected fluctuations in pool elevations of Make-Up Pond B and Make-Up Pond C.

The review team then reviewed the monthly average estimates of cooling-tower evaporative losses provided by Duke and listed in Section 3.2.2.2. The review team acknowledges that evaporative losses are a function of meteorological conditions and are subject to inter-annual variability not reflected in these monthly averages. In order to estimate evaporative losses, pan evaporation data from July 1948 through December 2010 is available for Clemson, South Carolina (Duke 2011e), which is approximately 80 mi west-southwest of the Lee Nuclear Station site. This data shows an annual average pan evaporation rate of about 55 in. The annual estimated free-surface evaporation from the makeup ponds is less than the estimated annual precipitation.

Section 316(b) of the CWA regulating withdrawals "… requires that the location, design, construction and capacity of cooling-water intake structures reflect the best technology available for minimizing adverse environmental impact…." from the proposed Lee Nuclear Station. Duke would be required to comply with either a withdrawal limitation of 5 percent of the mean annual flow, or propose an alternative requirement. In their NPDES application, Duke proposed an alternative requirement that would limit withdrawal from the Broad River for refill of Make-Up Ponds B and C to the months of July through February to minimize impacts to aquatic biota (Duke 2011a). During these months, a maximum withdrawal from the Broad River would be 304 cfs. In Duke's Water Management Plan, set forth in the NPDES application, withdrawals from the Broad River would never result in the lowest FERC minimum flow requirement downstream of Ninety-Nine Islands Dam being violated. The Proportional Flow Limitation refers to 5 percent of the mean annual flow of the river from which the water is being withdrawn (40 CFR 125.84(b)(3)(i)). The Proportional Flow Limitation is not an instantaneous flow limitation. In the NPDES application, two mean annual flows were provided by Duke. Based on its long-term estimated mean annual flow of 2495 cfs through 2010, Duke estimated 125 cfs as the 5 percent flow limit. However, the 316(b) rule states "… Historical data (up to 10 years) must be used where available…." (40 CFR 125.83, *Annual mean flow*). Based on a mean annual flow of 1956 cfs for only the past 10 years of flow data, Duke estimated 98 cfs as the 5 percent flow limit. Both values were provided in the NPDES application. The review team considered both these limits and additionally the 5 percent of the mean annual flow for the 2000 to 2010 period at the USGS gage (96 cfs) in its independent confirmatory assessment of the hydrological alterations that could occur as a result of operation of the proposed Lee Nuclear Station. Subsequently, the SCDHEC issued NPDES permit SC0049140 to Duke on July 17, 2013 (SCDHEC 2013a) for the Lee Nuclear Station. The permit states: "The design intake flows of 98 cfs for the primary section and 206 cfs for the drought contingency section may not be exceeded."

The South Carolina Surface Water Withdrawal, Permitting, Use, and Reporting Act (SC Code Ann 49-4) states that for a licensed or otherwise flow controlled impoundment, a surface-water withdrawal permit "… may not authorize the withdrawal of surface water in an amount that would cause a reservoir: (a) water level to drop below its minimum water level; or (b) to be unable to release the lowest minimum flow specified in the license for that impoundment as issued by the appropriate government agency." Article 402 of the FERC license for Ninety-Nine Islands Dam issued June 17, 1996 (amended November 15, 2011), specifies continuous minimum flows below the dam for three periods: 966 cfs for January through April; 725 cfs for May, June, and December; and 483 cfs for July through November. It is unclear from Article 402 whether each of the three minimums or just the lowest minimum (483 cfs) is the appropriate criterion to curtail withdrawals. The review team discussed the definition of minimum flows with FERC, and decided to evaluate both seasonal low-flow limitations and a single low-flow limitation (NRC 2011c, NRC 2012c).

As mentioned above, the review team independently estimated daily flows in the Broad River for 1925 to 2011. This flow record was used to estimate the changes in the Broad River flow and fluctuations in the water surface of Make-Up Ponds B and C. In this assessment, the following were explicitly considered: monthly evaporation rates; monthly forced evaporation from the cooling towers; both 483 cfs and seasonal FERC limitations; three Proportional Flow Limit values (125, 98, and 96 cfs) for withdrawals from the Broad River; and transfers between the makeup ponds. The assessment was based on the principle of conservation of mass, and calculated the water budget at a daily time scale.

The review team's independent confirmatory calculation was similar to that used by Duke. The review team determined that the differences between the review team's approach and Duke's were minor and provided the review team confidence that Duke's assessment was appropriate.

5.2.2 Water-Use Impacts

A description of water-use impacts on surface water and groundwater is presented in the next sections. The water resource usage by proposed Lee Nuclear Station Units 1 and 2 operations is limited to the Broad River drainage. Surface water would be used by the proposed Lee Nuclear Station Units 1 and 2 for cooling and all other plant water needs. No local groundwater use is proposed during operation. Information presented in Duke's ER for the proposed Lee Nuclear Station Units 1 and 2 (Duke 2009b, c), information obtained by the review team, and independent analyses performed by the review team were used to assess water-use impacts.

5.2.2.1 Surface-Water Use

The proposed Lee Nuclear Station Units 1 and 2 would withdraw water from the Broad River. Operational surface-water withdrawals for the proposed Lee Nuclear Station Units 1 and 2 are estimated to be 78 cfs during normal operation. For the USGS gage below Ninety-Nine Islands Dam, the mean annual flow in the Broad River was 1858 cfs for the period water years 2000 to 2010 (USGS 2010a). The estimated surface-water withdrawals for the proposed Lee Nuclear Station Units 1 and 2 (78 cfs) would be 4.2 percent of the mean annual flow. Duke's proposed design intake flow would comply with EPA's 316(b) Proportional Flow Limitation (40 CFR 125.84(b)(3)(i)), which states "… for cooling-water intake structures located in a freshwater river or stream, the total design intake flow must be no greater than 5 percent of the source waterbody annual mean flow." Duke's proposed normal withdrawal of 78 cfs is 4 percent of the mean annual flow from the 10-year period of 2001 to 2010 at the USGS gage below Ninety-Nine Islands Dam (1921 cfs). Furthermore, the SCDHEC issued NPDES permit SC0049140 to Duke on July 17, 2013 (SCDHEC 2013a) for the Lee Nuclear Station. The permit states: "The design intake flows of 98 cfs for the primary section and 206 cfs for the drought contingency section may not be exceeded." The 78 cfs withdrawal, however, does not include withdrawals associated with refilling the Make-Up Pond C as described in Duke's proposed alternative requirement to the proportional flow limitation (Duke 2011a).

The majority of water withdrawn would be consumptively used by the proposed Lee Nuclear Station Units 1 and 2 for station cooling, primarily through evaporation. The estimated surface-water normal consumptive use of 55 cfs (cooling-tower evaporation and drift) would be 3.0 percent of the mean annual flow of 1858 cfs for the period of record (water years 2000 to 2010) at the USGS gage below Ninety-Nine Islands Dam. During operations, the proposed Lee Nuclear Station Units 1 and 2 would consumptively use, through cooling tower evaporation and drift (Section 3.4.2.2) and natural evaporation from the makeup ponds (Section 3.2.2.2, Table 3-2), only a small proportion of the Broad River flow. Therefore, the review team concludes that the impacts on surface-water use in the Broad River, as a result of proposed Lee Nuclear Station Units 1 and 2 operations would be SMALL, and mitigation would not be warranted.

5.2.2.2 Groundwater Use

Duke stated that groundwater would not be used during operation of the proposed Lee Nuclear Station Units 1 and 2 (Duke 2009c). Based on the low permeability of the subsurface adjacent to Make-Up Ponds A and B and the relatively temporary drawdown of these ponds, the review team determined that the effects from drawdown-refill events on the groundwater resource due to the makeup ponds would be local, temporary, and infrequent.

As described in Section 4.2.2.2, wells located near Make-Up Pond C may exhibit increased water levels during filling of Make-Up Pond C. Similarly, decreased water levels may occur when the pond is used for plant makeup during droughts. Drawdown events would be infrequent and temporary. Drawdown of Make-Up Pond C would not drop the water table below levels existing prior to initial filling of Make-Up Pond C.

Because (1) there would be no use of groundwater during operation and (2) there would be only local and short-term effects from drawdown of the makeup ponds during low-river-flow events, the review team concludes that groundwater-use impacts due to operation activities would be SMALL and no mitigation would be warranted.

5.2.3 Water-Quality Impacts

This section discusses the impacts on the quality of water resources from the operation of the proposed Lee Nuclear Station Units 1 and 2. Surface-water impacts include thermal, chemical, and radiological wastes, and physical changes in the Broad River resulting from effluents discharged by the proposed units. Section 5.2.3.1 discusses the impacts on surface-water quality and Section 5.2.3.2 discusses the impacts on groundwater quality.

5.2.3.1 Surface-Water Quality

No effluents are proposed to be discharged to any of the makeup ponds. The only source of water to the makeup ponds will be stormwater and water pumped from the Broad River. As discussed in Section 3.2.2.2, effluents from all the various sources, except sanitary wastes, will be discharged through a single blowdown and wastewater discharge structure on the upstream side of Ninety-Nine Islands Dam in the Broad River. Sanitary wastes will be transferred to the Gaffney Board of Public Works Wastewater Treatment Plant. The residual heat in the blowdown water, the residual chemicals used to manage the water chemistry in the cooling towers, and the solutes from the Broad River water that have been concentrated through evaporation from the cooling tower are the factors that the review team considered. The impacts of liquid radiological effluent are discussed in Section 5.9.

Residual Heat in Blowdown Water

Blowdown water from the cooling system represents 98 percent of the discharge. Evaporation and heating of the air are the mechanisms used to dissipate heat in a closed-cycle cooling-tower design, such as proposed at the Lee Nuclear Station site. Water is discharged to control the water chemistry in the cooling-water system and not to dissipate heat to the river. However, the water in the cooling-tower basins is at an elevated temperature when it is discharged. The review team reviewed the document summarizing Duke's simulations of the thermal plume that used a numerical three-dimensional computational fluid dynamics model (Duke 2011a, 2013e).

The review team performed an independent calculation by directly applying the principle of conservation of energy to estimate the increase of temperature downstream of the dam assuming complete and partial mixing downstream of the dam. The review team obtained river temperatures from the USGS stream monitoring station on the Broad River near Carlisle, approximately 50 mi downstream from Ninety-Nine Islands Dam. This was the uppermost monitoring station operated by the USGS with extended water temperature data on the

Broad River that was also downstream of the proposed location of the Lee Nuclear Station site. The USGS monitoring station below Ninety-Nine Islands Dam does not have water temperature data. The Carlisle monitoring station had records of stream temperature measurements extending from October 1996 to January 2011. The review team identified January and August as months representative of the most extreme winter and summer conditions for this assessment. January 2011 was the month with the lowest recorded mean water temperature for the period of record (39°F). August 2007 was the month with the highest mean water temperature (86°F). The review team obtained the lowest monthly flows for January and August based on the USGS gage at the site (USGS 2011a). The lowest monthly mean flows for January and August were 865 and 242 cfs, respectively.

The review team conservatively assumed that the maximum blowdown temperature of 95°F (see Table 3-10) would occur concurrently with the lowest flow. The review team determined, assuming complete mixing of the normal blowdown downstream of the dam, that the temperature in the river would increase only 1.1 and 1.2°F in January and August, respectively. The review team also conservatively estimated the maximum fraction of the stream that could achieve a 5°F rise (typically used to define the extent of a thermal plume) under the warm summer period. The review team estimated that no more than 11 percent of the flow would sustain a temperature increase of 5°F.

In Section 5.2.3.1 of the ER, Duke presented results from a CORMIX (Cornell Mixing Zone Expert System) assessment. While CORMIX is widely used and recognized for discharge mixing-zone analyses, the review team determined that CORMIX was not appropriate for the specific conditions associated with proposed Lee Nuclear Station Unit 1 and 2 discharge. Duke's NPDES permit application included a mixing zone request (Part VI) that included a computational fluid dynamics model analysis of the thermal plume under extreme low-flow conditions (7Q10 of 438 cfs) for discharge temperatures of 95°F and 91°F and an ambient river temperature of 88.2°F. The modeled plume (greater than or equal to 90°F for the steady-state condition) reached a maximum length of 138 ft, width of 71 ft, and volume of 0.195 ac-ft when the discharge temperature was 95°F. At a discharge temperature of 91°F, the modeled plume reached a maximum length of 89 ft, width of 5 ft, and volume of 0.013 ac-ft. Because the top of the diffuser would be 10 ft below the water surface, the plume would mostly dissipate in the subsurface water column (Duke 2011a, 2013e). The review team determined that the use of the computational fluid dynamics modeling technique was appropriate.

Residual of Chemicals Used to Manage Water Chemistry in Cooling Towers

The waste stream concentrations of water-treatment chemicals estimated by Duke in the ER are presented in Table 3-8. Pursuant to 40 CFR Part 423, the chemicals in this waste stream are specifically regulated by the EPA to protect the environment. Duke's NPDES permit requires monitoring to ensure the environment is not adversely affected (SCDHEC 2013a).

Concentrated Solutes from Broad River

Table 3-8 presents Duke's estimates of concentration of the primary metals that will be in the blowdown water due to concentration of water from the Broad River. The review team acknowledges that some of the concentrations of some of the constituents in the blowdown will be above South Carolina State water-quality standards at the point of discharge. However, the constituents will be diluted back to ambient Broad River water-quality levels as the discharge mixes into the rest of the Broad River. The review team determined that the concentrations of the solutes would be diluted by the streamflow within a short distance below the dam, and any localized increase would be undetectable relative to background by the time the water reaches the City of Union, South Carolina public water supply intake 21 mi downstream of the discharge. Pursuant to the CWA, Duke's NPDES permit (Permit Number SC0049140) requires monitoring to ensure the environment is not adversely affected (SCDHEC 2013a).

Impacts on surface-water quality from the operation of the proposed Lee Nuclear Station Units 1 and 2 are limited to residual heat in blowdown water, water-treatment chemicals in blowdown water, and concentrated solutes from the Broad River. Based on its independent assessment, the review team concludes that surface-water-quality impacts of Lee Nuclear Station Units 1 and 2 operations would be SMALL, and additional mitigation would not be warranted.

5.2.3.2 Groundwater Quality

As discussed in Section 5.2.2.2, no groundwater would be used for the operation of the proposed Lee Nuclear Station Units 1 and 2. Additionally, neither active dewatering nor passive dewatering systems are proposed for the site. As a result, the only impact on groundwater quality would be from spills, the stormwater-management system, or from fluctuations in the elevation of Make-Up Pond C.

Best management practices (BMPs) would be applied to prevent spills and minimize their effects. The spill prevention, control, and countermeasure plan required by the SCDHEC pursuant to 40 CFR Part 112 will mitigate impacts on local groundwater because spills are quickly attended to and not allowed to penetrate to groundwater. Examples of materials that may spill during operation are diesel fuel, hydraulic fluid, and lubricants.

As mentioned in Section 3.2.2.1, the stormwater drainage systems would direct stormwater into Make-Up Pond A, Make-Up Pond B, or the Broad River. Therefore, the review team concluded that the alteration in groundwater quality from the stormwater-management system would be undetectable.

Groundwater quality in wells with a close hydraulic connection to proposed Make-Up Pond C may vary in response to fluctuations in the pool elevation during drought events as the pool elevation declines and after drought events when the pool refills. In the ER, Duke stated that temporary increases in turbidity may occur in wells close to Make-Up Pond C. Based on the overall expected stability of the pool elevation in Make-Up Pond C and the filtering provided by the subsurface environment, the review team determined that any changes to the groundwater quality of wells adjacent to Make-Up Pond C would be minor.

Impacts on groundwater quality from the proposed operation of proposed Lee Nuclear Station Units 1 and 2 and Make-Up Pond C are limited by the lack of groundwater use and the factors identified above. Based on all these factors, the review team concludes that groundwater-quality impacts of proposed Lee Nuclear Station Units 1 and 2 and Make-Up Pond C operations would be SMALL, and additional mitigation would not be warranted.

5.2.4 Water Monitoring

The NRC requires water monitoring for radiological protection. The USACE may require monitoring for other purposes. Duke's NPDES Permit, issued by SCDHEC on July 17, 2013 (Permit No. SC0049140), requires highly specific monitoring of discharges to surface water to ensure protection of water quality and biota (SCDHEC 2013a).

In Sections 5.2.3.5 and 6.2.2.1 of the ER, Duke has committed to perform operational monitoring for groundwater that would satisfy the applicable requirements of State and Federal agencies (Duke 2009c, 2013a).

5.3 Ecological Impacts

This section describes the potential impacts on ecological resources from the operation and maintenance of the proposed Lee Nuclear Station Units 1 and 2, existing Make-Up Ponds A and B, a new cooling-water reservoir (proposed Make-Up Pond C), transmission lines in two new corridors, and a renovated and partially rerouted railroad-spur corridor. The impacts are discussed for terrestrial and aquatic ecosystems.

5.3.1 Terrestrial and Wetland Impacts

Impacts on terrestrial communities and species related to operation of the proposed Lee Nuclear Station may result from cooling-system operations (including the cooling towers, water pipelines, and makeup ponds) and transmission-line and railroad-spur operations and maintenance. Operation of the cooling system could result in deposition of dissolved solids; increased local fogging, precipitation, or icing; increased risk of avifauna collision mortality; increased noise levels; and altered shoreline habitats of the source waterbody. Potential impacts to terrestrial species from operation and maintenance of the transmission system include maintenance of vegetation within the transmission-line, railroad-spur, and water-pipeline corridors; avian collision mortality and electrocution; and electromagnetic fields (EMFs).

5.3.1.1 Terrestrial Resources – Site and Vicinity

Vegetation

As described in Chapter 3, the proposed cooling system for the proposed Lee Nuclear Station is a closed-cycle system using circular mechanical draft cooling towers, with two towers per unit, two located west of proposed Unit 1 and two located east of proposed Unit 2 (Figure 3-1). The cooling towers would be 85 ft tall, 360 ft in diameter, and would have a concrete shell (Duke 2013a).

Through the process of evaporation, the total dissolved solids (TDS) concentration in the circulating-water system (CWS) increases. A small percentage of the water in the CWS is released into the atmosphere as fine droplets (i.e., cooling tower drift) containing elevated TDS levels that can be deposited on nearby vegetation. Vapor plumes and drift may affect crops, ornamental vegetation, and native plants, and water losses from cooling tower operation could affect shoreline habitat. Although the cooling towers would be equipped with drift eliminators to minimize the amount of water that is lost via drift, some droplets containing dissolved solids would be ejected from the cooling towers. According to Duke, this drift has essentially the same concentration of dissolved and suspended solids as the water in the cooling tower basins. Operation of the CWS would be based on four cycles of concentration, which means the TDS in the makeup water would be concentrated approximately four times the ambient concentration in the Broad River before being released (Duke 2009b).

Depending on the makeup source waterbody, the TDS concentration in the cooling tower drift can contain high levels of salts that, under certain conditions and for certain plant species, can be damaging. Vegetation stress can be caused by deposition of drift with high levels of total dissolved salts, either directly by deposition onto foliage or indirectly from accumulation in the soils. As discussed in Section 5.7.1, the review team estimates the cooling tower plumes to have a maximum cumulative deposition rate of approximately 0.0103 kg/ha/mo in the summer. The maximum deposition would occur 200 m north of the towers, on the Lee Nuclear Station site (Duke 2013a). These areas would be occupied by facilities, open/field/meadow, upland scrub, and mixed hardwood-pine cover types (Duke 2009c). The native species with the greatest sensitivity to salt deposition at existing nuclear power plants reviewed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996), was flowering dogwood (*Cornus florida*), which was affected at 4.8 kg/ha/mo, well over the 0.0103 kg/ha/mo estimated for the cooling towers proposed for Lee Nuclear Station. Because the maximum deposition for the proposed Lee Nuclear Station would be below the level that could cause leaf damage in a sensitive species, the impacts onsite would be negligible. The impact of drift on crops and ornamental vegetation also was evaluated for existing nuclear power plants in the GEIS and was found to be of minor significance (NRC 2013a). Thus, based on the overall maximum salt deposition rate, impacts to any ornamental vegetation that may be located around the cooling towers would be negligible also.

As discussed in Section 5.7.1, ground-level fogging will likely be infrequent, and no occurrences of ground-level icing are predicted. Thus, no impacts to native or ornamental vegetation or crops in the vicinity are expected.

Avian Collisions with Cooling Towers and Structures

A potential for avian mortalities resulting from collisions with proposed nuclear power plant structures exists and could adversely affect resident and migratory species populations. The shield buildings, the tallest and most visible structures on the site, each would be 229.5 ft above grade, and the cooling towers would be approximately 85 ft above grade (Table 3-10). The NRC previously concluded in the GEIS that the relatively low height of mechanical draft cooling towers causes negligible avian mortality (NRC 2013a). In addition, the NRC concluded that avian collisions are unlikely to pose a biologically significant source of mortality because of the small fraction of total bird mortality that has been attributed to collisions with nuclear power plant structures (NRC 2013a).

The proposed Lee Nuclear Station is located along a principal inland route of the Atlantic flyway (Bird and Nature 2011) and, thus, could have a higher propensity for avian collisions. Duke's other existing nuclear stations (Oconee [along Lake Keowee, South Carolina], McGuire [along Catawba River, North Carolina], and Catawba [along Catawba River, South Carolina]) also are situated along the same principal inland route of the Atlantic flyway and together can be expected to affect migrating birds cumulatively. Employees at all three of these nuclear stations have been trained in the *Duke Energy Corporation Avian Protection Plan* (Duke Energy 2009); therefore, the review team expects that any known incidences of avian mortality would have been reported (Duke 2008c). There is no evidence that avian collisions at these other three nuclear stations have negatively affected resident or migratory birds. Consequently, avian collisions with plant structures, including containment buildings and cooling towers, on the Lee Nuclear Station site are anticipated to have a negligible impact on resident and migratory populations.

Increased Vehicle Traffic

Operation-related increases in traffic would likely be most obvious on the rural roads of Cherokee County, specifically McKowns Mountain Road, which is a two-lane county road that will provide the only access to the proposed Lee Nuclear Station. The review team assumed current traffic on McKowns Mountain Road is 950 vehicles per day (Section 5.4.4.1). The capacity is 1700 vehicles per hour for each direction and 3200 vehicles per hour for both directions; however, the use of staggered work shifts make it unlikely that road capacities would be exceeded (Section 5.4.4.1). Increased traffic could slightly increase traffic-related wildlife mortalities. Local wildlife populations could suffer declines if roadkill rates were to exceed the rates of reproduction and immigration. However, while roadkill is a highly visible source of wildlife mortality, and would likely increase slightly during operations, except for special situations not applicable to the proposed Lee Nuclear Station (e.g., ponds and wetlands crossed by roads where large numbers of migrating amphibians and reptiles would be susceptible), traffic mortality rates rarely limit population size (Forman and Alexander 1998). Consequently, the overall impact on local wildlife populations from increased vehicular traffic on McKowns Mountain Road during operation of Lee Nuclear Station would be negligible.

Water-Pipeline Corridor Maintenance

The water-pipeline corridors are maintained for safety. Regeneration of trees and large shrubs in permanent water-pipeline corridors is prevented by mechanical mowing, cutting, trimming, or herbicide applications (Duke 2010o), much the same as vegetation management in transmission-line corridors (Section 5.3.1.2). The impacts of transmission-line corridor maintenance on wildlife and habitats, including floodplains and wetlands, was evaluated in the GEIS (NRC 2013a), and the impacts were found to be of minimal significance at operating nuclear power plants with associated transmission-line corridors of variable widths. Duke also has procedures in place that minimize adverse impacts to wildlife and important habitats, such as floodplains and wetlands, from transmission-line corridor maintenance (Duke 2008j). Such procedures also would be applied to maintenance of water-pipeline corridors. Consequently, the potential effects on terrestrial ecology from water-pipeline maintenance would be negligible, and mitigation beyond the use of standard BMPs would not be warranted.

Noise

Operation of the four mechanical draft cooling towers associated with the CWS would be the main source of continuous noise at the proposed Lee Nuclear Station. Each of the four cooling towers would generate approximately 85 A-weighted decibels (dBA) at close proximity and 55 dBA at 1000 ft (Table 3-10). Noise levels would be somewhat higher than 85 dBA near each pair of cooling towers because of the presence of multiple towers. This difference would not be prevalent offsite because of shielding from the cooling towers in each cluster and other plant structures (Duke 2009c). Thus, noise at distances greater than 1000 ft would be well below the 80- to 85-dBA threshold at which birds and small mammals are startled or frightened (Golden et al. 1980), and likely would not disturb wildlife in habitats away from the planned facilities. Further, areas within 1000 ft of any of the proposed cooling tower locations would consist primarily of open water and open/field/meadow and upland scrub vegetation (Duke 2009c) that, in an industrial setting, are of relatively low value to wildlife. Consequently, the potential impact on wildlife posed by incremental noise resulting from operation of the four mechanical draft cooling towers and other facilities on the proposed Lee Nuclear Station would be minimal, and mitigation would not be warranted.

Shoreline Habitat

Based on Figure 3-19, Make-Up Pond B would have experienced drawdowns ranging from 0.5 ft to a maximum of 30 ft below full pool elevation during 191 drawdown events in the 85-year period of record. The duration of these events would have ranged from 2 to 139 days (Table 3-6), with the longer durations associated with deeper drawdowns (Figure 3-20 and Table 3-6) and longer refill periods (Table 3-6). Most of the drawdowns would have occurred from mid-summer through fall (Duke 2009b), and to minimize entrainment of aquatic organisms in Make-Up Pond B, refills would not occur from March through June (Duke 2011a).

The Functional Assessment of Waters of the United States (Duke 2011h) identified three jurisdictional wetlands (total of 1.61 ac) located at the uppermost reach of Make-Up Pond B (USACE 2013a), that may be temporarily affected by the drawdowns (Duke 2013h) (Figure 2-13). The maximum water depth in these wetlands during the functional assessment was between 1 and 2 ft. The longer duration drawdowns with extended refill periods would likely result in the alteration of wetland vegetation and some mortality and displacement of associated wildlife. The wetlands could potentially recover after refilling Make-Up Pond B. These impacts are likely (but not certain) to occur sometime in the future depending on the severity of drought conditions. There are three additional jurisdictional wetlands (total of 0.29 ac) in the vicinity of Make-Up Pond B that are not expected to be affected by the drawdowns since they are not within the influence of Make-Up Pond B. In addition, the jurisdictional wetland south of the dam in the southeastern portion of Make-Up Pond B (Figure 2-13) would not be affected. The invert elevation of the overfill structure is 575 ft, which is approximately 5 ft higher than the full pond elevation of Make-Up Pond B (569.8 ft). The surface-water elevation of the southeastern portion of Make-Up Pond B is not expected to change as a result of the Make-Up Pond B drawdown (Duke 2013h).

Duke has established a shoreline management program at Make-Up Pond B to ensure there is no debris blockage of the spillway (Figure 2-13). As part of the annual inspection of the Make-Up Pond B shoreline, any trees that have fallen to the ground or show distress of falling into the pond are removed. Duke also inspects the spillway after any rainfall event greater than 3 in./hr to ensure the spillway remains clear of any debris. As a secondary measure, Duke will install a debris barrier system designed to rise and fall with fluctuations in the pond water level (Duke 2013f).

Duke has no plans to routinely draw down Make-Up Pond A to support power operations, and it is not required to be used for safe shutdown of the reactors (see Section 3.4.2.1 and Duke 2008f). Thus, it is not anticipated that the 3.85-ac jurisdictional freshwater marsh identified in the jurisdictional determination (USACE 2013a) on the southeast margin of Make-Up Pond A (Figure 2-13) would be significantly affected. Further, there apparently is no hydrologic connection between Make-Up Pond A and the 5.92 ac impoundment located just to the south (Figure 2-13). The earthen dam disconnects the impoundment, which is fed by natural inflows up-gradient of Make-Up Pond A (Duke 2008n). Thus, any reduction in the surface elevation of Make-Up Pond A, however minor, during operation of the proposed Lee Nuclear Station would not be expected to affect the 2.67-ac wetland associated with the impoundment (Figure 2-13).

Make-Up Pond C would provide about 620 ac of open water habitat and could potentially develop some littoral wetlands in areas of shallow bathymetry around its margins and in tributary areas (Duke 2010n, 2011h, 2012j) and, as previously mentioned in Section 3.3.1.8, a log boom would be installed to prevent debris from blocking the spillway (Duke 2012m). However, according to USACE operating procedures (USACE 2010a), the subsequent provision of open water habitat and possible eventual provision of some littoral wetlands following inundation of a stream system does not offset or reduce impacts to existing open water or wetland resources. Further, littoral wetlands that may develop in the future could also be affected by drawdowns of Make-Up Pond C (Figure 3-19), which could occur to a nominal drawdown less than or equal to 30 ft below full pool elevation. However, these occurrences are projected to be much less numerous than drawdowns of Make-Up Pond B based on the 85-year period of record (Figure 3-19). The future development and drawdown impacts to such wetlands are uncertain.

The potential effects on wetland vegetation and wetland wildlife from drawdown of the makeup ponds resulting from operation of the proposed Lee Nuclear Station would be minor because of expected refilling and recovery. These impacts are likely (but not certain) to occur sometime in the future depending on the severity of drought conditions, and the effects may be temporary in nature (Duke 2011h).

The Cherokee Reservoir Dam (commonly called Cherokee Lake Dam) has already reduced flows in London Creek below the dam, especially during drought periods. Make-Up Pond C would likely further reduce the downstream flow of London Creek, particularly during drought periods, and would permanently alter its flow patterns and water fluctuations. London Creek may experience less frequent overbank flood events downstream of the proposed dam; however, the remaining segment of London Creek would still receive floodwaters from the backwater effect of the Broad River. Few wetlands downstream of the proposed dam derive their water from overbank flooding from London Creek flows. Floodplain wetlands downstream of the railroad crossing adjacent to London Creek likely derive most of their water from the backwater effects associated with Ninety-Nine Islands Reservoir during flood events. Other wetlands downstream of the dam are associated with Little London Creek, which will not be affected by Make-Up Pond C (see Section 9.5). Potential effects, if any, to downstream resources, such as wetlands, between the Make-Up Pond C dam and the Broad River would be at least somewhat ameliorated by minimal seasonal flow releases from Make-Up Pond C to London Creek downstream of Make-Up Pond C dam (January through April 1.5 cfs; May, June, and December 1.0 cfs; July through November 0.75 cfs) (Duke 2012m). Thus, any impacts to wetlands located between Make-Up Pond C and the Broad River by adding the Make-Up Pond C dam are anticipated to be minor.

Wastewater Treatment Basins

Two wastewater retention basins would be built to treat plant waste streams (Figure 3-4). Both would be smaller than Hold-Up Pond A (4.2 ac) (Duke 2009c). They would be designed, constructed, and operated such that they would not provide or develop littoral habitat or surface acreage that would readily attract most birds. However, if birds frequent the basins and are exposed to harmful substances or if the birds hinder the effective functioning of the basins, bird exclusion devices (e.g., propane cannons, bird repellent dispersion systems, netting, etc.) would be employed to dissuade birds from frequenting the basins (Duke 2008c).

Avian Protection Policy and Plan

In connection with the potential impacts to birds discussed in this section, Duke Energy has instituted an *Avian Protection Plan* (Duke Energy 2009). In accordance with the plan, Duke intends to ensure compliance with the Migratory Bird Treaty Act of 1918 and all other avian protection regulations and laws. A Duke corporate goal is to manage bird interactions with power generation and transmission facilities, related facilities, and equipment in order to reduce system interruptions caused by birds. Some of Duke's expectations are to:

- comply with migratory bird laws, regulations, permit requirements, and guidelines
- document bird mortalities and injuries and disturbances of active nests through the U.S. Fish and Wildlife Service (FWS) and South Carolina Department of Natural Resources (SCDNR) Migratory Bird Depredation Permits (MB000257-0 and MD-19-10, respectively) (Duke 2010d)
- provide information, resources, and training to improve employee and contractor awareness of responsibilities under bird protection laws.

Nighttime Security Lighting

Light pollution could affect the behavioral and population ecology of wildlife. These effects derive from light-induced disorientation, and attraction or repulsion from the altered light environment. These behavioral effects, in turn, may impact foraging, reproduction, migration, and communication, which could lead to mortality (Longcore and Rich 2004).

The security lighting system for the proposed Lee Nuclear Station is required to conform to NRC requirements in 10 CFR 73.50 and 10 CFR 73.55. Light pole height for stadium-style lighting is expected to be 80 ft. Light pole height along roadways and parking lots is expected to be 35 ft. Lighting requirements are not less than 0.2 foot-candles measured horizontally at ground level (Duke 2008c).

The security lighting system for the proposed Lee Nuclear Station would be similar to that at Duke's other existing nuclear stations (Oconee, Catawba, and McGuire). No incidences of bird or bat mortality have been reported at these other nuclear stations (Duke 2009m), and there is no evidence that would indicate the NRC-required security lighting has negatively affected migrating birds and bats or other wildlife. In addition, the Oconee and Catawba Nuclear Stations, and to a lesser extent the McGuire Nuclear Station, are situated along the same principal inland route of the Atlantic Flyway (Bird and Nature 2011) as the proposed Lee Nuclear Station. Further, there are no known local wildlife migratory corridors or migration routes at the Lee Nuclear Station site that would differentiate it from the other three nuclear station sites. Consequently, the security lighting system for the proposed Lee Nuclear Station is not anticipated to have any adverse effects on wildlife.

Railroad Spur Operation

The relatively open railroad bed contains dense vegetation, including species often consumed by eastern box turtles (*Terrapene carolina*), and large puddles in the railroad corridor provide water and prey (e.g., amphibian larvae) (Dorcas 2009c). Although this habitat would likely be destroyed during renovation of the railroad spur and possibly result in some mortality and displacement (Section 4.3.1.4), the species would remain in surrounding areas and could continue to be affected by railroad operation. The operating railroad could result in the direct mortality of box turtles and fragmentation of the habitat. Unless tunnels or ramps are provided to pass under or over the rails, box turtles could become trapped between the rails and succumb quickly to overheating or predation (Dorcas 2009c).

Dredged Material Disposal

As part of normal operations, areas around the Broad River intake structure and the intake structure of Make-Up Pond A would need to be dredged periodically (Duke 2008o, 2009b). The estimated frequency of maintenance dredging and quantity of dredged material are discussed for each of the above facilities in a response to a request for additional information provided by Duke (2008o). Dredged material disposal would be either in an approved county landfill or in an onsite spoils area (Duke 2009b). Thus, there would be no additional habitat or wildlife impacts from dredged material disposal.

5.3.1.2 Terrestrial Resources − Transmission-Line Corridors

Cutting and Herbicide Application

Duke has over 13,000 circuit miles of transmission lines ranging from 44 kV to 525 kV and has an established Integrated Vegetation Management Program (Duke 2008j). The program employs various corridor-management tools, such as mowing; hand cutting; removing dead, diseased, dying or decaying trees; pruning; and applying environmentally safe herbicides. Within the corridors, vegetation height is managed to not exceed 15 ft. To eliminate undesirable woody species while promoting lower growing vegetation, herbicides are used where it is deemed environmentally sound to do so. Herbicides are applied to corridors approximately every 4 years. Where herbicides are not used (e.g., in wetlands), mechanical mowing or hand cutting is employed approximately every 3 years. Encroaching lateral growth is removed by pruning. All corridors and lines are inspected via helicopter twice a year (Duke 2008j).

The impacts of transmission-line corridor maintenance on wildlife and habitats, including floodplains and wetlands, were evaluated in the GEIS (NRC 2013a), and the impact was found to be of minimal significance at operating nuclear power plants with associated transmission-line corridors of variable widths (NRC 2013a). Duke has procedures in place that minimize adverse impacts to wildlife and important habitats such as floodplains and wetlands (Duke 2008j).

However, such procedures do not necessarily enhance wildlife habitat, including habitat for grassland bird species (wholly or largely dependent upon upland grasslands for their survival) and other species that occupy similar early-successional environments. Birds that use grasslands (e.g., loggerhead shrike [*Lanius ludovicianus*], see Section 4.3.1.6) have shown some of the steepest population declines of any bird group in North America. Vegetative succession and permanent loss, degradation, and fragmentation of grassland and scrub/shrub habitat resulting from urban development and intensified agriculture are primary factors resulting in the long-term population declines experienced by grassland birds (SCDNR 2005). Warm-season (rather than cool-season) sod-forming grasses (Rothbart and Capel 2006) and native forbs and small shrubs (SCDNR 2005) may be employed in transmission-line corridors to provide for greater plant and wildlife diversity. Such plant communities provide enhanced habitat conditions for avian species (Yahner et al. 2003), as well as white-tailed deer (*Odocoileus virginianus*) and amphibian, reptile, small mammal, and butterfly species that are adapted to early-successional environments (Yahner 2009, SCDNR 2005). Duke will collaborate with the SCDNR to develop and maintain transmission-line corridor vegetation where possible to provide suitable habitat for grassland birds and other wildlife species that occupy similar early-successional environments (Duke 2012m). Consequently, the potential effects on terrestrial species and habitats from vegetation maintenance in the Lee Nuclear Station transmission-line corridors are anticipated to be beneficial, and mitigation beyond the use of standard BMPs would not be warranted.

Avian Collisions and Electrocutions – High-Voltage Transmission Lines

Duke would implement the following guidelines for minimizing avian electrocutions and collisions on transmission lines associated with the proposed Lee Nuclear Station (Duke 2008c). These guidelines are based on recommendations of the Avian Power Line Interaction Committee (APLIC 2006):

1. Provide a minimum 60-in. horizontal separation between phase conductors or between a phase conductor and grounded hardware/conductor. The 60-in. separation is accepted industry practice based on the wingspan (wrist to wrist) of the bald eagle (*Haliaeetus*

leucocephalus), the largest bird known from the vicinity of the Lee Nuclear Station site. A vertical separation between conductors or conductor to ground of 48 in. also would be provided based on the height of long-legged wading birds such as the great blue heron (*Ardea herodias*), which is common along the Broad River.

2. Transmission towers offer nesting opportunities for raptors, especially ospreys (*Pandion haliaetus*). If ospreys (or other raptors) establish nests on transmission towers and the nests do not pose a risk to the osprey or the reliability of electricity transmission, the nests would be left in place. If the nests pose a risk to the osprey or the reliability of electricity transmission, artificial nesting platforms would be installed near the affected transmission towers so nest materials and excrement do not contaminate the lines. If artificial nest platforms cannot be installed because of right-of-way restrictions or access limitations, nest discouragers and other exclusion techniques would be employed.
3. Where topography or habitat inhibit transmission-line visibility to birds, or where there are sections of line that birds tend to cross more frequently, the installation of flight diverters or other marking devices on the static or neutral wires would be implemented to increase line visibility.

The NRC's analysis in the GEIS (NRC 2013a) determined that bird collisions with transmission lines are of small significance at operating nuclear power plants, including plants with variable numbers of transmission lines. Thus, addition of the two proposed transmission lines would likely present few new opportunities for bird collisions and would not be expected to cause a measurable reduction in local bird populations. Consequently, the incremental number of bird collisions posed by the operation of the two new transmission lines for the proposed Lee Nuclear Station would be negligible, and mitigation would not be warranted.

Impacts of Electromagnetic Fields on Flora and Fauna

EMFs are unlike other agents that have an adverse impact (e.g., toxic chemicals and ionizing radiation) in that dramatic acute effects cannot be demonstrated and long-term effects, if they exist, are subtle (NRC 2013a). The NRC reviewed biological and physical studies of EMFs but found no consistent evidence linking harmful effects with field exposures (NRC 2013a). The NRC determined that EMFs produced by operating transmission lines for existing nuclear power plants up to 1100 kV were not linked to significant harmful effects on flora (NRC 2013a). Minor damage to plant foliage and buds can occur near strong electric fields, caused by heating of the leaf tips and margins. Damage does not appear within the stem and root systems of the plants and would not significantly affect growth (NRC 2013a).

EMFs have been demonstrated to affect some fauna. Voltage buildup can affect the overall health of honeybee hives (NRC 2013a). Birds that nest within transmission-line corridors experience chronic EMF exposure, but lines energized at levels less than 765 kV do not affect terrestrial biota (NRC 2013a).

The NRC concluded that the impacts of EMFs on terrestrial flora and fauna appear to be of small significance at operating nuclear power plants, including power transmission systems with variable numbers of transmission lines (NRC 2013a). Therefore, the review team concludes that the incremental EMF impact on flora and fauna posed by the operation of the proposed transmission lines for the Lee Nuclear Station would be minimal and mitigation would not be warranted.

5.3.1.3 Important Terrestrial Species and Habitats

In a letter dated April 9, 2008, the NRC requested that the FWS Field Office in Atlanta, Georgia, provide information regarding Federally listed, proposed, and candidate species and critical habitat that may occur in the vicinity of the Lee Nuclear Station (NRC 2008e). On May 13, 2008, the FWS provided a response letter indicating three listed and one candidate terrestrial species and no critical habitat in Cherokee, Union, and York Counties (FWS 2008a), which encompass the Lee Nuclear Station site, the Make-Up Pond C site, the railroad-spur corridor, the two proposed transmission-line corridors, and the six offsite road improvement areas (Table 2-9). These species include the pool sprite (*Amphianthus pusillus*), Georgia aster (*Symphyotrichum georgianum* [formerly *Aster georgianus*]), dwarf-flowered heartleaf (*Hexastylis naniflora*), and Schweinitz's sunflower (*Helianthus schweinitzii*). An additional listed species identified that may occur in the project area is the smooth coneflower (*Echinacea laevigata*)(Cantrell 2008). These species were surveyed, and only the Georgia aster, a Federal candidate species, was observed on or in the vicinity of the project footprint (Make-Up Pond C study area [see Section 2.4.1.6]). The Georgia aster was found only in an area that would be inundated by the creation of Make-Up Pond C, so this species would not be affected by operations. In a letter dated June 13, 2012, the FWS concurred with the review team's determination that the proposed Lee Nuclear Station Units 1 and 2 project is not likely to adversely affect Federally protected species nor result in adverse modification to designated or proposed critical habitat, thus completing informal consultation between the FWS and the NRC (FWS 2012b). Consultation correspondence between the review team and the FWS is included in Appendix F.

Duke surveyed for the State-ranked species discussed in Section 2.4.1.6. None of these species was found in those parts of the project footprint not expected to have previously been altered or inundated during site-development activities, but which would be affected by the operation and maintenance impacts described above.

Therefore, there would be no impacts to known Federally threatened, endangered, proposed, or candidate animal or plant species and no impacts to known State-ranked species from operation of the proposed Lee Nuclear Station, including Make-Up Pond C, and the two proposed transmission lines and railroad spur, and maintenance of transmission-line corridors, water-pipeline corridors, and offsite road improvements. There are no important habitats on the Lee Nuclear Station site other than wetlands. There are wetlands and three important habitats

(Rhododendron Bluff, London Creek Bottoms, Little London Creek Bottoms) in the Make-Up Pond C study area outside the inundation zone (see Sections 2.4.1.2 and 4.3.1.2). The three important habitats would not be affected by operation of Make-Up Pond C. Operational impacts to wetlands from drawdown of Make-Up Ponds B and C are discussed in Section 5.3.1.1.

5.3.1.4 Terrestrial Monitoring During Operations

Duke does not plan to conduct any terrestrial ecological monitoring during the period of operation of the proposed Lee Nuclear Station.

5.3.1.5 Potential Mitigation Measures for Operations-Related Terrestrial Impacts

Duke has committed to employing mitigation measures for operations-related terrestrial impacts including the implementation of BMPs associated with transmission-line operation and corridor-maintenance practices. As described in the above sections, these BMPs include vegetation-management BMPs to avoid impacts to wetlands and floodplains, BMPs to minimize avian electrocutions and collisions on transmission lines, and implementation of Duke's *Avian Protection Plan* (Duke Energy 2009).

5.3.1.6 Summary of Operational Impacts on Terrestrial Resources

The potential impacts of operating the proposed Lee Nuclear Station and the associated cooling system (mechanical draft cooling towers) on vegetation, birds, and shoreline habitat are likely to be minor. The potential impacts of transmission-line operation, including those from EMFs, on birds, and transmission-line corridor maintenance on important habitats, including floodplains and wetlands, are considered minor, assuming related BMPs are implemented. The potential impacts of water-pipeline corridor maintenance, increased traffic, wastewater-treatment basin operation, dredged material disposal, railroad-spur operation, and nighttime security lighting on wildlife are likely to be minor.

The review team evaluated the potential terrestrial ecological impacts of operating the proposed Lee Nuclear Station, including the heat-dissipation system, transmission lines, associated corridor maintenance, and other sources of potential adverse effects. Given the information provided in the ER submitted by Duke (Duke 2009c) and the supplement to the ER (Duke 2009b), responses to RAIs, interactions with State and Federal agencies, the public comment process, and the review team's own independent assessment, the review team concludes the impacts from operation of the proposed new facilities and associated new transmission lines on terrestrial resources would be SMALL, and additional mitigation beyond that mentioned in the text would not be warranted.

5.3.2 Aquatic Impacts

This section discusses the potential impacts of operating the proposed Lee Nuclear Station Units 1 and 2 and the associated operation and maintenance of the transmission-line corridors on the aquatic resources in the Broad River, onsite waterbodies, Make-Up Pond C, and water courses crossed by the transmission-line corridors and the railroad-spur corridor.

5.3.2.1 Aquatic Resources – Site and Vicinity

The potential impacts to aquatic resources through operation of the proposed Lee Nuclear Station Units 1 and 2 are described below according to operational systems and their respective impacts. Therefore, this section describes potential impacts from the Broad River intake system, makeup pond intake systems, and blowdown and wastewater discharge system, respectively.

Broad River Intake System

A closed-cycle cooling tower system is proposed for the proposed Lee Nuclear Station Units 1 and 2. Depending on the quality of the makeup water, closed-cycle, recirculating cooling-water systems can reduce water use by 96 to 98 percent of the amount that the facility would use if it employed a once-through cooling system (66 FR 65256). This significant reduction in the water withdrawal rate results in a corresponding reduction in impingement and entrainment losses.

The primary intake system proposed for the proposed Lee Nuclear Station would be located on the Broad River approximately 1.5 mi upstream of Ninety-Nine Islands Dam on the south bank of the reservoir (Duke 2009c). This Broad River intake structure would provide Make-Up Pond A with makeup water for both the cooling water system and service-water system (SWS) cooling towers, provide water for intake screen-washing flow and for separating fish from debris, and provide water for refilling Make-Up Pond B and Make-Up Pond C after periods of low-flow operation (Duke 2009b). Planned configuration and plan views of the proposed Broad River intake structure are shown in Figures 3-6 and 3-7, respectively. A cross-section view of the Broad River intake structure is shown in Figure 3-8.

The Broad River intake structure would be a single structure with two sections named by Duke as the river water subsystem (also known as the primary section) and the refill subsystem (also known as the drought contingency section). The river water subsystem would withdraw water from the Broad River and supply it to Make-Up Pond A. From Make-Up Pond A, the water can be transferred to Make-Up Pond B. The refill subsystem would withdraw water from the Broad River and supply it to either Make-Up Pond B or Make-Up Pond C. Water then can be transferred between Make-Up Ponds B and C and between Make-Up Ponds A and B. Each subsystem has four forebays, each of which includes a steel bar/trash rack assembly, a dual-flow traveling screen, and an intake pump (Duke 2010f). The traveling screens with ⅜ in. or smaller mesh would allow a flow velocity of less than 0.5 fps through the screens (Duke 2009c, 2012i). Based on information contained in the ER submitted by Duke, the average raw water withdrawal flow rate for two units operating simultaneously is expected to be 35,030 gpm (78 cfs), and the maximum raw water withdrawal flow rate is estimated to be 60,000 gpm (134 cfs) during the power operation mode (Duke 2009c). The four intake pumps associated with the river water subsystem would operate continuously under normal water conditions; the remaining four intake pumps associated with the refill subsystem would be operated when permit conditions on the Broad River support supplemental water withdrawals to refill Make-Up Ponds B and C (Duke 2010f).

Impingement and Entrainment

A major factor affecting impingement and entrainment losses is the percentage of source waterbody flow past the site that is being withdrawn for cooling-water purposes. EPA determined that limiting withdrawal to 5 percent of the source waterbody mean annual flow was technically achievable and economically practicable, and that larger withdrawals may result in greater levels of entrainment (66 FR 65256). Section 316(b) of the CWA regulates withdrawals for the proposed Lee Nuclear Station. Duke would be required to comply with either a withdrawal limitation of 5 percent of the mean annual flow, or propose an alternative requirement. In its August 2011 NPDES application, Duke has proposed an alternative requirement that would limit withdrawal from the Broad River for refill of Make-Up Ponds B and C to the months of July through February to minimize entrainment of aquatic organisms (Duke 2011a). Duke's Water Management Plan is provided verbatim in Section 3.4.2.1. The NPDES permit issued by SCDHEC to Duke on July 17, 2013 (Permit No. SC0049140) calls for Duke to not operate the drought contingency section of the river intake during the months of March, April, May, or June (SCDHEC 2013a).

A second factor affecting impingement and entrainment losses is the hydraulic zone of influence (HZI), defined by EPA in 66 FR 65256 as "… that portion of the source waterbody hydraulically affected by the cooling-water-intake structure withdrawal of water." The review team reviewed the *Cooling Water Intake Structures Hydraulic Zone of Influence Study* prepared for Duke by Geosyntec Consultants (Geosyntec). This study is Attachment 5 in the Lee Nuclear Station NPDES application prepared by Duke and submitted to the SCDHEC (Duke 2011i). Geosyntec used existing data from field surveys and computational fluid dynamics modeling to simulate the flows induced by the intakes (both the Broad River intake and the makeup pond intakes) and then developed an HZI for each intake. Geosyntec modeled three pumping scenarios for the Broad River intake structure: (1) mean annual flow for the past 10 years of data (1956 cfs) and withdrawal of 98 cfs through the primary intake section, (2) low flow (538 cfs) and withdrawal of 78 cfs (normal operation) through the primary intake section, and (3) high river flow (2260 cfs) during a makeup pond refill period and withdrawal of 98 cfs through the primary intake section and 206 cfs through the drought contingency section. For the first scenario, the HZI is 0.129 ac-ft, with a surface area of 0.004 ac that extends into the Broad River a maximum of

9.2 ft perpendicular to the intake structure. The HZI for the second scenario is 0.200 ac-ft, with a surface area of 0.013 ac that extends 14.4 ft into the river. The third scenario results in an HZI of 0.316 ac-ft, with a surface area of 0.025 ac that extends 15.4 ft into the river (Duke 2011i). Because the width of the river is 240 ft at the intake, the HZI would likely not exceed 6.5 percent of the river's width under any of the modeled scenarios. The vast majority of fish eggs and larvae drifting down the river susceptible to entrainment and the fish susceptible to impingement would be unaffected by the water withdrawal of the Broad River intake structure, thereby minimizing entrainment and impingement losses.

For aquatic resources, one of the primary concerns related to water intake is the potential for organisms to be impinged on the intake screens. Impingement occurs when organisms are trapped against the intake screens by the force of the water passing through the cooling-water-intake structure (66 FR 65256). Impingement can result in starvation and exhaustion, asphyxiation (water velocity forces may prevent proper gill movement or organisms may be removed from the water for prolonged periods of time), and descaling (66 FR 65256).

Design features incorporated into the Broad River intake structure include a curtain wall, stop-log assemblies, and bar screens designed to keep logs and debris away from the pumps. Each of the two Broad River intake subsections incorporates four dual-flow traveling screens with a maximum through-screen velocity of less than 0.5 fps for all flows when the river surface elevation is greater than 508 ft above mean sea level (MSL), which is the approximate low-water pumping elevation (Duke 2009c, 2010l, 2012h). The design through-screen velocity for the intake greatly influences the rate of impingement of fish and shellfish at a facility. The higher the through-screen velocity, the greater the number of fish impinged. The EPA established a national standard for new facilities for the maximum design through-screen velocity of no more than 0.5 fps (66 FR 65256). The EPA determined that species and life stages evaluated in various studies could endure a velocity of 1 fps and then applied a safety factor of 2 to derive the threshold of 0.5 fps. Thus, the proposed screen design for the proposed Lee Nuclear Station meets the EPA criteria.

The traveling screens located behind the bar screens are designed to minimize the number of aquatic organisms that are impinged or entrained. Duke plans to use a modified "Ristroph" design (or equivalent) with Fletcher-type, fish-friendly buckets (Duke 2009c). In a study performed for the Electric Power Research Institute, this type of screen exhibited greater than 95 percent survival for all species tested (EPRI 2006). The screens will be equipped with backwashing spray systems and separate buckets for debris and fish. Supplemental water flow will move the fish to a trough that will return them to the Broad River downstream of the Broad River intake structure (Duke 2009c). All of these features will reduce impacts of impingement.

Impingement studies have not been conducted at the Lee Nuclear Station site because no units are present. The Oconee Nuclear Power Station located on Lake Keowee, which is part of the Savannah River Basin in South Carolina, uses a once-through heat-dissipation system. At

Oconee Nuclear Power Station, the most common fish reported as impinged on the station's stationary screens was the Threadfin Shad (*Dorosoma petenense*), estimated at more than 90 percent (NRC 1999b). This species is susceptible to experiencing cold stress, losing equilibrium, and becoming moribund, and is vulnerable to impingement when the water temperature decreases rapidly or when the temperature reaches a critical threshold (McLean et al. 1982). Other species impinged included the Yellow Perch (*Perca flavescens*) and Bluegill (*Lepomis macrochirus*). At the Lee Nuclear Station site, both Threadfin and Gizzard Shad (*D. cepedianum*) are present, but typically, their populations are sparse (Bettinger et al. 2003). However, based on the propensity for shad to become impinged at other cooling-water-intake structure sites, especially during cold winter months, and on the overall percent species composition in the vicinity of the Broad River intake structure, it is likely that Gizzard Shad, Bluegill, and other sunfish (centrarchid) species will be the most common fish impinged (Bettinger et al. 2003). Based on the use of closed-cycle cooling, the low through-screen velocity (less than 0.5 fps), the small HZI, and the location and design of the intake structure, including dual-flow traveling screens with fish-return system, the review team concludes that impacts from impingement of fish at the proposed Lee Nuclear Station Units 1 and 2 would be minor.

For aquatic resources, another of the primary concerns related to water intake is the potential for organisms to be entrained into the cooling-water system. Entrainment occurs when organisms are drawn through the Broad River intake structure into the proposed Lee Nuclear Station Units 1 and 2 cooling system. Organisms that become entrained are normally relatively small benthic, planktonic, and nektonic (organisms in the water column) forms, including early life stages of fish and shellfish, which often serve as prey for larger organisms (66 FR 65256). Entrained organisms are subject to mechanical, thermal, and toxic stresses as they pass through the cooling system. For this analysis, the review team assumes 100 percent mortality as a result of entrainment.

The use of design and building technologies for the Broad River intake system can minimize entrainment. The EPA indicated (66 FR 65256) that the optimal design requirement for the intake location is to place the inlet in an area of the source waterbody where impingement and entrainment of organisms are minimized by locating intakes away from areas with the potential for high productivity. The Broad River intake structure location was purposefully placed near the deepest part of the reservoir (approximately 35-ft depth) where common Broad River fish species are less likely to spawn (Duke 2009c, 2013a). Ichthyoplankton surveys performed in the 1970s showed that many more fish larvae were present in backwater areas of Ninety-Nine Islands Reservoir than in the area where the intake structure is proposed (Table 5-1) (Olmsted and Leiper 1978). Of the six fish groups sampled in 1975 and 1976, only catfish and sucker larvae were always captured more often in the mainstream than in the backwater areas. These two fish groups had very low capture rates relative to other fish groups such as sunfish and shad. Based on this data set and on the habitat characteristics of the Broad River intake structure location, the intake area does not appear to be an area of high productivity.

Table 5-1. Data on Larval Fish Densities Near the Lee Nuclear Station Site, 1975 to 1976

Fish Group	Sampling Location	Larvae per 1000 m^3	
		1975	**1976**
Clupeids (shad)	Backwater	601	1390
	Mainstream	39	52.9
Cyprinids (minnows)	Backwater	3.4	3.5
	Mainstream	1.3	35.5
Catostomids (suckers)	Backwater	2	---
	Mainstream	5.1	6.7
Ictalurids (catfish)	Backwater	---	---
	Mainstream	---	14.8
Centrarchids (sunfish)	Backwater	356.3	373.4
	Mainstream	5	6.5
Centrarchids (crappie)	Backwater	154.8	9.2
	Mainstream	---	---

Source: Olmsted and Leiper 1978

Entrainment studies have not been conducted at the Lee Nuclear Station site because no units exist. However, for the reasons listed below, the review team concludes that the impacts to the aquatic organisms of the Broad River from entrainment would be minor:

- the planned low through-screen intake velocity (less than 0.5 fps)
- the use of closed-cycle cooling
- the small HZI
- compliance with either a withdrawal limitation of 5 percent of the mean annual flow or SCDHEC approval to implement the operational restrictions included in the Duke water management plan (Duke 2011a)
- the location of more suitable spawning habitat in the backwater areas for many of the Broad River fish species
- the low abundance of fish larvae found in the vicinity of the proposed Broad River intake structure
- the typically high fecundity of most species in the river system, and many of the Broad River species' spawning habits (i.e., nest-building rather than broadcast spawning).

Make-Up Pond Intake Systems

Secondary intake and discharge structures would exist in Make-Up Ponds A, B, and C. The design of the proposed intake structure for Make-Up Pond A is shown in Figure 3-9 (configuration), Figure 3-10 (plan view), and Figure 3-11 (cross section). A plan view of the Make-Up Pond B intake/refill structure is shown in Figure 3-12, a side-profile view is provided in

Figure 3-13, and a cross-section view through the concrete wet well of the Make-Up Pond B intake/discharge structure is shown in Figure 3-14. A plan view of the Make-Up Pond C intake/discharge structure is shown in Figure 3-15, a side-profile view is provided in Figure 3-16, and a cross-section view is shown in Figure 3-17.

The modeled HZIs for Make-Up Ponds A, B, and C are localized and small. Under the worst-case modeling scenarios, the HZI extends 7.2 ft outward of the Make-Up Pond B intake structure and 9.2 ft from both the Make-Up Pond A and C intake structures. Complete details of the modeling scenarios are provided in Attachment 5 of the NPDES application (Duke 2011i).

Impingement, Entrainment, and Operational Maintenance

The current intake design for Make-Up Pond A includes dual-flow type traveling screens with a fish-return system (Duke 2012h). Dual screens allow the intake footprint to be narrower than the footprint of traditional single screen types. A spray wash system would help remove debris from the face of the screens. Debris not removed by the spray wash system would be returned to the unscreened waterway rather than being carried over to the clean water side as in a more traditional system. The screens would consist of ⅜-in. or smaller mesh and would have a through-screen velocity less than 0.5 fps to meet CWA §316(b) requirements (Duke 2010f, 2012i). The low intake velocity and fish-return system should minimize fish impingement in Make-Up Pond A. Ichthyoplankton passing through the intake would be assumed to experience 100 percent mortality.

The Make-Up Pond B and Make-Up Pond C intakes would be passive wedge-wire cylindrical drum screens with through-screen flow velocities less than 0.5 fps. The proposed range of slot sizes for the wedge wire are a maximum of 0.375 in. (9.5 mm) to a minimum of 0.079 in. (2.0 mm) (Duke 2010o, p). The intakes would be only operated intermittently, thereby reducing the potential for impingement and entrainment. Impingement also would be minimized by the low through-screen velocity. The intake screens in Make-Up Pond B would have a submerged centerline depth of 42 ft at the full pond elevation and a submerged centerline depth of 12 ft at the 30-ft drawdown elevation. The intake screens within the Make-Up Pond C reservoir would have a submerged centerline depth of 97 ft at the full pond elevation and a submerged centerline depth of 67 ft at the 30-ft drawdown elevation. Therefore, the Make-Up Pond C intake would always be below the thermocline (estimated to be at approximately 20 ft depth in summer) and away from shallow areas where fish tend to spawn and young fish reside (Duke 2009b; 2010o, p). However, ichthyoplankton passing through the intake would be assumed to have a 100 percent mortality rate. The intake screens would be removed from the ponds periodically for cleaning and maintenance (Duke 2010l).

Operational Impacts at the Lee Nuclear Station Site

Low-Flow Operations

Duke plans to use water from Make-Up Ponds B and C to supplement Broad River flows during low-flow conditions (Duke 2009c). Make-Up Pond B would be drawn down first. If Make-Up Pond B drawdown reaches 30 ft, drawdown from this pond would cease and water would be withdrawn from Make-Up Pond C to a nominal drawdown less than or equal to 30 ft (Duke 2011h).

Water level fluctuations can affect all forms of aquatic biota. The severity of the impact depends upon the magnitude, duration, and timing of the fluctuation and the species involved (Cott et al. 2008). Anthropogenic disturbances in particular can cause water level fluctuations that exceed the ability of aquatic organisms to adapt either physiologically or behaviorally (Coops et al. 2003; Cott et al. 2008). For example, extended exposure of shoreline when water is withdrawn could result in the loss of benthic invertebrates, aquatic plants, eggs of various aquatic organisms (including fish), and even juvenile life stages of some species, especially those that lay eggs or rear in shallow waters before a drawdown occurs (Heman et al. 1969; Cott et al. 2008). Even small changes of water level can result in dramatic shifts in aquatic plant communities (Coops et al. 2003). Extended drawdowns may increase the presence of invasive plant species (Cooke et al. 2005). It also should be noted, however, that purposeful drawdowns are used in many parts of the country to enhance existing aquatic macrophyte and fish populations or to control invasive species (Heman et al. 1969; Cooke et al. 2005; Cott et al. 2008). The difference is that intentional drawdowns used to manage particular species are timed to provide the most benefit versus cost, whereas a drawdown associated with low-flow conditions in the Broad River would not be pre-planned to maximize any benefits. Because the timing and extent would not be known in advance, the negative impacts could be more noticeable than under natural or planned conditions.

Because cooling systems typically withdraw from the deeper, cooler portion of the water column of lakes or reservoirs and discharge warmer water to the surface, they have the ability to alter thermal stratification of the surface water (NRC 2013a). The proposed volume of Make-Up Pond C was calculated based on the assumption that the proposed Lee Nuclear Station would continue operating during periods of low flow without disrupting the natural thermal stratification or turnover pattern as required to comply with CWA §316(b) requirements (Duke 2010l). To determine the volume of water required to provide a “zone of refuge” for fish in the event of a full drawdown of Make-Up Pond C, Duke determined that three similar reservoirs in the region typically showed thermal stratification at a depth of approximately 20 ft during the spring and summer months (i.e., the top 20 ft of the reservoir was thermally mixed and provided enough oxygen for aquatic life while the water below 20 ft was colder and less oxygenated). Construction of Make-Up Pond C at an elevation that would provide the full 20 ft of pond preserved as an aquatic refuge would not be feasible because of design constraints based on existing topography (Duke 2011h). Further analysis by Duke as part of the CWA §316(b) compliance demonstration showed the natural stratification and turnover pattern would be maintained by preserving the upper 17 ft of the pond as an aquatic refuge. The volume of water required to provide this 17-ft depth to fish was calculated, assuming 18 ft of dead storage volume was provided to keep the intake pump submerged and the volume of makeup water required to keep the station operating over an estimated 77 days of pumping to support station operation during an extreme low-flow event was withdrawn. In summary, Make-Up Pond C was sized with a total volume of approximately 22,000 ac-ft at a full pond surface elevation of 650 ft above MSL (Duke 2011h). This was based on:

- dead storage volume in the bottom 18 ft of the reservoir (537 to 555 ft above MSL): 147 ac-ft
- usable volume to support station operations (555 to 633 ft above MSL): 12,770 ac-ft
- volume in upper 17 ft of the reservoir (633 to 650 ft above MSL): 9106 ac-ft.

Water withdrawn from Make-Up Pond B or Make-Up Pond C would be used for power station operation and then discharged to the Broad River rather than being returned to the originating makeup pond. Thermal stratification would be maintained because water is removed from the bottom of the reservoir. However, as water is withdrawn from the ponds, the volume of water contained in the upper 17 ft decreases. Thus, while the mixed, oxygenated water above the thermocline may be maintained to 17 ft, the competition of fish vying for the more limited space may increase, based on the amount of water withdrawn and the bathymetry of the reservoir.

River Discharge System

The potential impacts to the Broad River from operation and maintenance of the proposed Lee Nuclear Station Units 1 and 2 would include effects of heated effluents on aquatic resources, chemical impacts, and physical impacts from discharge and dredging.

Thermal Impacts from Discharge

Thermal impacts to the aquatic environment can include effects associated with the discharge of heated water into the Broad River (acute or chronic effects) or the interruption of heated-water releases caused by planned or unplanned shutdowns resulting in cold shock. Section 3.2.2.2 provides a discussion on the location and design of the discharge piping. The discharge water, or blowdown from the plant, would be routed through a 36-in. inner-diameter pipe along the upstream face of the dam. The 88-ft-long diffuser pipe would be perforated with 64 4-in. ports spaced 1.4 ft apart that discharge horizontally (Duke 2011a). The centerline elevation of the diffuser pipe would be 11.75 ft below full pond elevation (Duke 2011h). The diffuser would be located approximately 750 ft from the west shore near the Ninety-Nine Islands Dam trash sluice structure (Duke 2011a). Complete mixing of the discharge with river water is assumed once the water is pulled through the hydroelectric facility.

The review team conservatively assumed the maximum plant blowdown temperature of 95°F (see Table 3-10) would occur concurrently with the lowest river flow. The review team also determined, assuming complete mixing of the normal blowdown downstream of the dam, that the river water temperature downstream of the dam would increase only 1.1°F and 1.2°F in January and August, respectively. While Table 3-10 provides a maximum discharge flow rate of 64 cfs, the review team determined that this condition would not likely occur in the critical low-flow conditions because water would be coming from Make-Up Pond B or Make-Up Pond C and, therefore, would be unlikely to encounter high sediment concentrations that could cause a sustained drop in the number of cycles of concentration feasible. The highest monthly mean river water temperature was 86°F in August 2007. Thus, the addition of the heated discharge to the Broad River would not likely increase temperatures in the river below Ninety-Nine Islands Dam above 90°F.

Currently, the SCDHEC requires that Broad River water temperatures not increase more than 5°F above ambient river temperatures and that river temperatures not exceed 90°F as a result of heated- water discharges, with the exception of a defined mixing zone, which would need to be granted by the SCDHEC (SCDHEC 2008a). On July 17, 2013, SCDHEC issued NPDES Permit No. SC0049140 to Duke for the Lee Nuclear Station (SCDHEC 2013a). The NPDES permit, effective September 1, 2013, requires Duke to submit for SCDHEC's approval a plan for confirmatory monitoring (confirming the accuracy of the computational fluid dynamics modeling that was used to support the thermal and toxicity mixing zone requests) within one year of the effective date of the permit. As stated on page 31 of the NPDES permit:

> The plan shall address the following elements: temperature monitoring methods, locations, and schedule; summer conditions monitoring to verify >90°F temperature plume does not extend beyond #4 turbine inlet; winter conditions monitoring to verify >5°F temperature increase plume does not extend beyond #4 turbine inlet; and consideration of timing of monitoring so that modeled scenarios (i.e. river temperature, river flow, discharge volume, and discharge temperature) are captured to the extent practical.

The thermal tolerance for fish is defined in different ways. Some definitions relate to the temperature that causes fish to avoid the thermal plume, other definitions relate to the temperature that fish prefer for spawning, and others relate to the temperatures (upper and lower) that may kill individual fish. A list of the upper and lower lethal thresholds for several important species found in the Broad River was compiled in the *Final Environmental Statement Related to Construction of Cherokee Nuclear Station, Units 1, 2, and 3* (NRC 1975a); this information is presented in Table 5-2. In every case, the upper lethal threshold is at least 7°F above the acclimation temperature and often is above the 90°F upper limit set by the SCDHEC, indicating that most fish species would be able to tolerate the increase in water temperature created by the thermal discharge from the proposed Lee Nuclear Station Units 1 and 2. The

White Sucker (*Catostomus commersonii*) is the only species with upper lethal thresholds consistently below 90°F. These fish would likely have sought areas away from the discharge area where ambient water temperatures are consistently cooler. In these areas, the White Sucker would not likely be affected because of the small size of the thermal discharge plume.

Table 5-2. Lethal Temperature Thresholds of Important Adult Fish Species of the Broad River

Species	**Acclimation Temperature**		**Upper Lethal Threshold**		**Lower Lethal Threshold**	
(Scientific Name)	°C	°F	°C	°F	°C	°F
Largemouth Bass (*Micropterus salmoides*)	20.0	68	32.5	90.5	5.5	41.9
	25.0	77	34.5	94.1		
	30.0	86	36.4	97.5	11.8	53.2
White Sucker (*Catostomus commersonii*)	5.0	41	26.3	79.3		
	10.0	50	27.7	81.9		
	15.0	59	29.3	84.7		
	20.0	68	29.3	84.7	2.5	36.5
	25.0	77	29.3	84.7	6.0	42.8
Channel Catfish (*Ictalurus punctatus*)	15.0	59	30.4	86.7	-17.8	0.0
	20.0	68	32.8	91.0	-17.8	0.0
	25.0	77	33.5	92.3	-17.8	0.0
Bluegill (*Lepomis macrochirus*)	15.0	59	30.5	86.9	2.5	36.5
	20.0	68	32.0	89.6	5.0	41.0
	25.0	77	33.0	91.4	7.5	45.5
	30.0	86	34.6	94.2	11.0	51.8

Smallmouth Bass (*Micropterus dolomieu*) are unique in this part of the Broad River, and concerns have been raised that increased water temperatures resulting from operating the proposed Lee Nuclear Station could negatively affect the population. A 1993 report by the FWS summarized data on temperature response criteria for Smallmouth Bass (Armour 1993). Several critical temperatures included in the report that may be relevant to Broad River fish are presented in Table 5-3. The review team determined, assuming complete mixing of the normal blowdown downstream of the dam, that river water temperature would only increase 1.2°F in August. Even under the warmest water conditions recorded in August (monthly mean temperature of 86°F from August 2007), there should be no significant impact to the bass during any part of their lifecycle, especially if SCDHEC limitations are observed (Duke 2009c). Also, the small area of increased temperature would limit the extent of any impact.

Table 5-3. Temperature Response Criteria for Smallmouth Bass

Criterion	Value	Comments
Maximum weekly average temperature for adequate adult and juvenile growth	32 to 33°C (90 to 91°F)	---
Short-term maximum temperature for adult and juvenile summertime growth	35°C (95°F)	---
Short-term maximum temperature for embryo development	23°C (73°F)	Author of the study estimated that this temperature was conservative and that a maximum of 26°C (79°F) is more realistic for spawning and embryo protection.
Final preferred temperature	27°C to 31.5°C (81 to 89°F)	These were the minimum and maximum final preferred temperatures from three separate studies.

Source: Adapted from Armour 1993

Based on the previous discussion, the review team concludes that the thermal impacts on the fish populations from the discharge of heated water from the proposed Lee Nuclear Station Units 1 and 2 would be minor, and additional mitigation would not be warranted.

Invasive nuisance organisms found in Ninety-Nine Islands Reservoir include one fish (Smallmouth Buffalo [*Ictiobus bubalus*]) and one mussel (Asiatic clam [*Corbicula fluminea*]) (Duke 2009c). Smallmouth Buffalo are tolerant of warm waters during all life stages. They are thought to potentially compete with redhorse sucker species (*Moxostoma* spp.), which prefer slightly lower water temperatures (Edwards and Twomey 1982). However, the small size of the discharge plume and small change in temperature would minimize the impact to native aquatic resources in the Broad River. Similarly, the Asiatic clam also can tolerate warm waters. However, neither species is expected to proliferate beyond the immediate vicinity of the plant as a direct result of station thermal discharge; therefore, potential impacts from invasive species are considered to be minor.

Cold shock occurs when aquatic organisms that have been acclimated to warm water are exposed to a sudden temperature decrease. This sometimes occurs when single-unit power plants shut down suddenly in winter or when an unseasonably cold weather event occurs. Cold shock mortalities at U.S. nuclear power stations are relatively rare and typically involve small numbers of fish (NRC 2013a). It is less likely to occur at a multiple-unit plant, as is proposed for the proposed Lee Nuclear Station, because the temperature decrease from shutting down one unit is moderated by the heated discharge from the unit that continues to operate. In addition, gradual shutdown of plant operations generally precludes cold shock events (NRC 2013a). It is also less of a factor when the discharge is to a river where the volume of the discharge in comparison to the flow of the river is very small, as is the case at the Lee Nuclear Station site.

Even at the proposed maximum rate of discharge (64 cfs), the proposed two new nuclear units should discharge less than 5 percent of the mean annual Broad River flow.

The NPDES permit application submitted by Duke included a computational fluid dynamics model analysis of the thermal plume under winter conditions when the temperature difference between the discharge temperature (maximum 70.4°F) and the river water temperature (mean of approximately 44.1°F in January) would be at its maximum. Results of this modeling indicate that the greater than 5°F plume would be limited to a narrow band in the immediate vicinity of the diffuser, would dissipate before reaching the surface, and would have a maximum depth of approximately 11.5 ft (Duke 2013e). This represents a limited cross-sectional area of the forebay and limits potential exposure to the greater than 5°F plume for free-swimming fish or benthic organisms and their passive life stages. In addition, the small area of thermal enhancement should limit attraction of fish. The submerged multiport diffuser, not fully considered by the computational fluid dynamics model, would provide rapid mixing of the thermal discharge, further reducing the size of the mixing zone, and mitigating impacts to aquatic resources from thermal discharge. Based on the previously discussed analysis, the review team concludes that the thermal impacts on fish populations resulting from cold shock would be minor, and additional mitigation would not be warranted.

Chemical Impacts from Discharge

Other discharge-related impacts include chemical treatment of the cooling water. The ER submitted by Duke indicates that chemicals would be added to the CWS, SWS, demineralized water-treatment system, steam generator blowdown system, and clarification system (Duke 2009c). Biofouling would be controlled using sodium hypochlorite and sodium bromide. These chemicals are used successfully at the Catawba Nuclear Station on the Catawba River, another river located in the Piedmont area in South Carolina. Monitoring data developed under conditions of the Catawba NPDES permit have shown no chemicals present in the blowdown waters above the No-Observable Effects Concentration, a risk assessment parameter that represents the concentration of a pollutant that will not harm the species involved with respect to the effect (e.g., survival, growth, or reproduction) being studied (Duke 2009c). Table 3-9 provides a list of the water-treatment chemicals, frequency of use, and the concentrations expected to be discharged from the proposed Lee Nuclear Station. The review team compared the ecological toxicity data from Material Safety Data Sheets (MSDS) for each of the chemicals to concentrations in the discharge. In every case, the concentrations in the discharge are lower than the LC_{50} (the concentration that kills 50 percent of the sample population in a given time) obtained from the MSDS. The water flow from the Broad River would further dilute the concentration of these chemicals.

Chemical constituents naturally occurring in Broad River water would also be present in the liquid discharge, concentrated by cooling water recirculation and losses to evaporation. Table 3-8 presents Duke's estimates of concentration of the primary metals that will be in the blowdown water due to concentration of water from the Broad River. The review team acknowledges that some of the concentrations of some of the constituents in the blowdown will be above South Carolina State water-quality standards at the point of discharge. However, the constituents will be diluted back to ambient Broad River water-quality levels as the discharge mixes into the rest of the Broad River. The review team determined that the concentrations of the solutes would be diluted by the streamflow within a short distance below the dam, and any localized increase would be undetectable relative to background by the time the water reaches the City of Union, South Carolina. Pursuant to the CWA, Duke has obtained an NPDES permit from SCDHEC (Permit No. SC0049140, issued July 17, 2013 and effective September 1, 2013), which establishes monitoring requirements to ensure the environment is not adversely impacted (SCDHEC 2013a).

Based on the estimated discharge concentrations and the successful use of water-treatment chemicals at another nuclear power station in the region without negative impacts to aquatic resources, the impacts from the chemical discharges to the Broad River should be minimal. As noted above, the SCDHEC worked with Duke to develop an appropriate NPDES permit for the site that requires monitoring and adherence to chemical discharge limits (SCDHEC 2013a). Duke's NPDES permit application included a Whole Effluent Toxicity mixing zone request (Duke 2011a). In January 2013, Duke submitted a revised Whole Effluent Toxicity mixing zone request to the SCDHEC. The revised proposed mixing zone has a length of 84 m (276 ft) and a width of 23 m (76 ft) (Duke 2013e).

Physical Impacts from Plant Discharge and Dredging

Scouring at the plant discharge site is expected because the bottom of the discharge pipe would be approximately 7.5 ft above the river bottom (Duke 2011h). Water from the diffuser would be dispersed horizontally into the water column from 64 4-in. holes spaced 1.4 ft apart over an 88-ft length of a 36-in. inner-diameter high-density polyethylene pipe (Duke 2011a). Some loss of benthic organisms would be expected from the continual discharge of water. Bottom substrates in the area are currently mud and silt. Surveys for benthic invertebrates around the Lee Nuclear Station have shown that such habitat supports fewer ephemeroptera, plecoptera, and trichoptera taxa, resulting in low bioclassification scores (Duke 2008a). Thus, because the discharge is in a place where macroinvertebrate habitat is already degraded, additional scouring would not likely negatively impact the overall aquatic health of the ecosystem.

Dredging can affect aquatic biota in a variety of ways, but it is generally assumed that organisms living on or in the affected sediments will be killed. In addition, suspended sediments may settle onto and bury adjacent habitats, clog the feeding structures of filter-feeding organisms, or temporarily reduce light penetration. The recovery of benthic communities in habitats disturbed by dredging depends on such factors as the character of the remaining sediments, the sources of organisms available to recolonize the area, and the size of the disturbed area. Recovery of benthic communities may take weeks to several years.

Maintenance dredging at the Broad River discharge site is not expected (Duke 2008p). Duke Energy calculated the settling velocity of typical Broad River silt particles to be 0.0001 fps; thus, there would be little chance for sediment to accumulate near the diffuser end of the discharge pipe (Duke 2008p). Sediment could accumulate during a period when the Ninety-Nine Islands Hydroelectric facility does not operate, but the forebay has enough capacity to hold at least 4 months of sediment accumulation under this unlikely scenario (Duke 2008p). Periodic maintenance dredging would be required at the Broad River intake structure. Duke estimated the dredged material volume at approximately 150 yd^3 per year (primarily medium sands), but also stated that they did not anticipate dredging annually (Duke 2008o, 2012b, j). Maintenance dredging events would impact a relatively small area and would be short term; therefore, impacts would be localized and temporary. Benthic macroinvertebrates would likely recolonize the area quickly. Duke estimated periodic maintenance dredging of Make-Up Pond A also would be necessary (Duke 2009b). Maintenance dredging events would be infrequent, and the soft-sediment environment would speed recovery from the effects of dredging in the pond. All dredging would be performed in accordance with SCDHEC and Department of the Army permit conditions. Dredged material disposal would be either in an approved county landfill or in an onsite spoils area (Duke 2009b).

Because Make-Up Pond B and Make-Up Pond C would receive water only during refill operations (i.e., to replenish water levels due to loss from evaporation or from use during low-flow periods), sedimentation rates are expected to be variable, but slow, and maintenance dredging would not be required (Duke 2009b).

Based on this analysis of the potential for physical impacts to the aquatic ecosystem from the discharge of cooling water to the Broad River and maintenance dredging activities, and the review team's own independent assessment, the review team concludes that the physical impacts from thermal discharges from the proposed Lee Nuclear Station and maintenance dredging at the Broad River intake structure and in Make-Up Pond A would be minor.

5.3.2.2 Aquatic Resources – Transmission-Line Corridors

Maintenance activities along the proposed transmission-line corridors could lead to periodic temporary effects on the waterways being crossed. However, it is assumed that the same vegetation-management practices used by Duke for its other existing transmission-line corridors at Oconee and Catawba Nuclear Stations in South Carolina and McGuire Nuclear Station in North Carolina would be applied to the proposed new transmission-line corridors. Duke practices and procedures were developed as tools to help meet or exceed the requirements of the SCDHEC, so that impacts to aquatic ecosystems from operation and maintenance of transmission-line corridors would be minor. Along transmission-line corridors, activities near streams are minimized by the use of buffer zones to decrease the possibility of negative impacts. For example, only hand cutting is allowed within 50 ft of a stream, and tall-growing species are cut only if they will affect lines in the future (Duke 2007c).

The review team concludes that the impacts of transmission-line corridor maintenance activities on aquatic resources would not adversely impact aquatic ecosystems, and additional mitigation beyond that described above would not be warranted.

5.3.2.3 Important Aquatic Species and Habitats

The principal impacts from operation of the proposed Lee Nuclear Station Units 1 and 2 on the important aquatic species listed in Section 2.4.2 would be from operation of the cooling-water intake and discharge systems.

Federally Listed Species

There are no Federally listed threatened or endangered species known to exist at the Lee Nuclear Station site, as described in Sections 2.4.2 and 4.3.2. There are no areas designated as critical habitat for threatened and endangered species in the vicinity of the Lee Nuclear Station site. In a letter dated June 13, 2012, the FWS concurred with the review team's determination that the proposed Lee Nuclear Station Units 1 and 2 project is not likely to adversely affect Federally protected species or result in adverse modification to designated or proposed critical habitat, thus completing informal consultation between the FWS and the NRC (FWS 2012b). In a letter to the National Marine Fisheries Service (NMFS) dated August 14, 2012, the NRC staff documented its no-effect determination for the Shortnose Sturgeon (*Acipenser brevirostrum*) and the Atlantic Sturgeon (*A*. *oxyrinchus oxyrinchus*) and considered its consultation with NMFS under the Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, and Fish and Wildlife Coordination Act for the proposed Lee Nuclear Station to be complete (NRC 2012d). Consultation correspondence between the review team and the FWS and NMFS is listed in Appendix F.

State-Ranked Species

One State-ranked fish species, the Carolina Fantail Darter *(Etheostoma brevispinum*) has been found in areas potentially affected by operation of the proposed Lee Nuclear Station. It is ranked S1, or critically imperiled statewide because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation. Until recently, the Carolina Fantail Darter was known as the subspecies *E. flabellare brevispinum.* Based on new research, the Carolina Fantail Darter has been elevated to species level (Blanton and Schuster 2008). Previous records of *E. flabellare* in this region were likely *E. brevispinum*.

The Carolina Fantail Darter has been captured in the vicinity of the proposed Broad River intake structure (Duke 2009c). Although it has only been captured in very low numbers, as described in Section 2.4.2.3, it is possible that this fish species could be affected by operation of the Broad River intake structure. The primary impacts are likely to be impingement, entrainment, or a decrease in suitable habitat due to water consumption and heated-water discharge by the proposed Lee Nuclear Station Units 1 and 2. The Carolina Fantail Darter lays adhesive eggs on the underside of stones, which makes it unlikely the eggs could be entrained. The fish prefer to inhabit riffles and runs with rocky substrate. Because this habitat type does not exist near the proposed intake structure, and because of the limited HZI at the intake, it would be uncommon for Carolina Fantail Darters to become impinged or entrained at the Broad River intake structure. According to the Duke NPDES application, consumptive use of water by the proposed Lee Nuclear Station could reduce water flow in the Broad River by up to 3 percent on an annual basis (Duke 2011a). Because the river fluctuates greatly over the course of any year, riverine fish species such as the Carolina Fantail Darter are already well adapted to changes in the amount of wetted habitat. By itself, the amount of water used by the Lee Nuclear Station is unlikely to cause significant losses to Carolina Fantail Darter habitat. The tailrace of Ninety-Nine Islands Dam does contain some rocky habitat; however, as discussed in Section 5.3.2.1, it is unlikely that this fish species would be significantly affected by thermal discharge from the Lee Nuclear Station because of the small increase in temperature over ambient conditions and the small size of the thermal plume.

Additional Species of Ecological Importance

As discussed in Section 4.3.2.3, five fish species, listed as highest or high priority conservation species by the SCDNR (2005), were found during surveys conducted by Duke or the SCDNR in the Broad River in the vicinity of the proposed Lee Nuclear Station site, in London Creek, or in tributaries to the Broad River that may be crossed by new transmission-line corridors associated with the proposed Lee Nuclear Station. These species may be affected negatively through impingement or entrainment at the Broad River intake system; thermal, chemical, or physical impacts from operation of the Broad River discharge system and dredging; maintenance activities along the proposed transmission-line corridors, or by low flows within London Creek.

According to Bettinger et al. (2003), the Highfin Carpsucker (*Carpiodes velifer*) was possibly captured in the tailraces of Cherokee and Ninety-Nine Islands dams. Because the species prefers faster flowing water, it is unlikely to be affected by operation of the Broad River intake system or transmission-line-corridor maintenance. As described in Sections 5.3.2.1 and 5.3.2.2, thermal, physical, and chemical impacts due to operation of the Broad River discharge system are unlikely to affect the Highfin Carpsucker.

The Quillback (*C. cyprinus*) and the Piedmont Darter (*Percina crassa*) were previously found in the Ninety-Nine Islands Reservoir near the proposed Lee Nuclear Station site (Bettinger et al. 2003). These species could be subject to impingement or entrainment at the Broad River intake system, but the intake location, design and operating parameters (e.g., low through-screen velocity) would minimize any potential loss. As described in Sections 5.3.2.1 and 5.3.2.2, thermal, physical, and chemical impacts due to operation of the Broad River discharge system are unlikely to affect these species. Because the Quillback and Piedmont Darter were not found in waters associated with the proposed transmission-line corridors, they are unlikely to be affected by transmission-line-corridor maintenance.

The Seagreen Darter (*Etheostoma thalassinum*) was found in Thicketty Creek, which would be crossed by the planned new transmission-line corridors (Bettinger et al. 2006). As described in Section 5.3.2.2, because Duke would comply with SCDHEC regulations when performing transmission-line-corridor maintenance activities near water, impacts of operation and maintenance to the Seagreen Darter are expected to be minimal.

The Greenhead Shiner (*Notropis chlorocephalus*) was found in London Creek during 2010 surveys (SCDNR 2011b). Most of the creek would be impounded during construction to form proposed Make-Up Pond C. However, the Greenhead Shiner could still potentially inhabit the remaining, short section of London Creek below the impoundment or in Little London Creek. Currently, no minimum flow requirements are in place from Cherokee Dam to London Creek (Duke 2009b); however, Duke has proposed minimum seasonal flow releases from Make-Up Pond C to London Creek downstream of Make-Up Pond C dam (January through April 1.5 cfs; May, June, and December 1.0 cfs; July through November 0.75 cfs) (Duke 2012m). This proposed minimum flow regime would maintain existing water uses and protect the remaining aquatic resources downstream of the Make-Up Pond C Dam to the confluence of London Creek with the Broad River (Duke 2012c). In addition, the primary flow path cell of the new concrete box culvert for the railroad-spur crossing London Creek would have a roughened channel with engineered stream-bed material to create a more natural channel flow for the passage of fish and other aquatic organisms (Duke 2012j).

Recreational Species

As described in Section 2.4.2.3, Ninety-Nine Islands Reservoir and the Broad River support a recreational fishery that consists mainly of sunfish, bass, Black Crappie (*Pomoxis nigromaculatus*), catfish, and suckers. As described in Section 5.3.2.1, the operation of the Broad River intake and discharge structures is not expected to noticeably alter populations of recreational fish species.

Diadromous Fish Species

As described in Section 2.4.2.1, it is possible that fish-passage programs could extend the range of diadromous fish species in the Broad River. It is possible the American Eel (*Anguilla rostrata*) and American Shad (*Alosa sapidissima*) could eventually be found in waters near the proposed Lee Nuclear Station. Thermal, chemical, and physical impacts to reintroduced diadromous fish species from operation of the Broad River intake and discharge systems are expected to be minimal as previously described in Section 5.3.2.1. In a letter to the NMFS dated August 14, 2012, the NRC concluded its consultation with the NMFS under the Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, and

Fish and Wildlife Coordination Act for the Lee Nuclear Station COL application. In the event of successful implementation of the fish-passage program as described in the *Santee River Basin Accord for Diadromous Fish Protection, Restoration, and Enhancement* (SRBA 2008), the NRC staff will consider potential thermal, chemical, and physical impacts to Federally protected species from operations at the Lee Nuclear Station (NRC 2012d).

5.3.2.4 Aquatic Monitoring

Duke has not committed to formal monitoring of the aquatic ecosystems during operations other than that required as a condition of their NPDES permit (Duke 2009c, 2011a; SCDHEC 2013a). The permit requires flow and temperature monitoring and monitoring of certain chemical constituents in the discharge (SCDHEC 2013a). The NPDES permit is required for the entire duration of plant operation and must be renewed every 5 years with provisions for updating monitoring programs and parameters, as necessary.

5.3.2.5 Summary of Operational Impacts on Aquatic Resources

The review team has reviewed the potential impacts of operating the proposed Lee Nuclear Station and the associated Broad River intake system, Make-Up Ponds A, B, and C intake and discharge systems, Broad River discharge system, and transmission-line corridors on aquatic resources. Impingement and entrainment impacts to aquatic ecology of the site and environs from operation of the Broad River intake structure are likely to be minimal. The use of closed-cycle cooling, the low through-screen velocity (less than 0.5 fps), the limited HZI, and the location and design of the intake structure, including dual-flow traveling screens with fish-return system, all contribute to this finding. Impacts to aquatic biota from operation of intakes in Make-Up Ponds A, B, and C are also likely to be minor. The dual-flow traveling screen design proposed for Make-Up Pond A will have low through-screen velocities (less than 0.5 fps) and a fish-return system. The intakes in Make-Up Ponds B and C will be operated only intermittently and will be equipped with passive wedge-wire, drum-type screens with a through-screen velocity less than 0.5 fps. In addition, these intakes would be located in deep-water areas away from primary fish spawning and rearing habitat, and each intake will have a limited HZI. Operation of Make-Up Ponds A, B, and C will not disrupt the natural stratification or turnover in these ponds.

Impacts on aquatic organisms in the Broad River due to the discharge could result from thermal, chemical, and physical effects on the substrate, and hydrological changes. Thermal impacts on the fish populations from the discharge of heated water from the proposed Lee Nuclear Station Units 1 and 2 are expected to be minor because of the small increase in temperature over ambient conditions and the small extent of the thermal plume which limits the number of fish that could be affected. Therefore, the review team concludes that thermal impacts on the fish populations would be minor, and additional mitigation would not be warranted. Based on the estimated discharge concentrations and the successful use of the water-treatment chemicals planned for proposed Lee Nuclear Station Units 1 and 2 at another nuclear power station in the region, the impacts from chemical discharges to the Broad River are expected to be minimal. Also, the SCDHEC worked with Duke to develop an appropriate NPDES permit for the site that requires monitoring and adherence to chemical discharge limits (SCDHEC 2013a). Physical impacts of scouring from the Broad River discharge also are expected to be minimal based on the relative low discharge rate (normally 18 cfs), the design of the multiport diffuser, and the already degraded benthic habitat. Thus, physical impacts from thermal discharges from the proposed Lee Nuclear Station would be minor.

Hydrological alterations resulting from future maintenance dredging activities at the Broad River intake structure and Make-Up Pond A would be localized, involve minimal quantities, and be conducted in accordance with SCDHEC and Department of the Army permit conditions and Duke BMPs. Impacts would be temporary and negligible.

The review team also concludes that the impacts of transmission-line corridor maintenance activities on aquatic resources would not adversely impact aquatic ecosystems because accepted BMPs, already used at three other Duke nuclear power stations in North Carolina and South Carolina, will be followed.

Impacts to the State-ranked Carolina Fantail Darter fish species are expected to be minimal based on its habitat preferences and adhesive egg-laying characteristics. In addition, should fish passage eventually be restored and diadromous fish species (e.g., American Eel or American Shad) reach Ninety-Nine Islands Dam or Ninety-Nine Islands Reservoir, these fish should not be negatively affected by Lee Nuclear Station operation for the reasons presented in Section 5.3.2.1.

Based on the previous discussions, the review team concludes that the aquatic ecological impacts to the Broad River, the onsite ponds, Make-Up Pond C, and waters crossed by the transmission-line corridors from the operation and maintenance of the proposed Lee Nuclear Station facilities and associated new transmission lines would be SMALL, and additional mitigation would not be warranted.

5.4 Socioeconomic Impacts

Operations activities can affect individual communities, the surrounding region, and minority and low-income populations. This evaluation assesses the impacts of operations-related activities and of the operations workforce on the region. Unless otherwise specified, the primary source of information for this section is the Duke ER (Duke 2009c). According to its Integrated Resource Plan (Duke 2013b), Duke expects to bring proposed Lee Nuclear Station Units 1 and Unit 2 online in 2024 and 2026, respectively.

Although the review team considered the entire region within a 50-mi radius of the Lee Nuclear Station site when assessing socioeconomic impacts, the primary region of interest for physical impacts is that within a 10-mi radius. The region of interest with regard to social and economic impacts encompasses the entire 50-mi radius, but primarily includes Cherokee and York Counties in South Carolina. The review team recognizes that many operations workers will live in more populated areas that have more amenities and services, such as the Spartanburg/Greenville area in South Carolina; Boiling Springs, South Carolina; and Shelby, Kings Mountain, and Charlotte, North Carolina. These areas are large cities or near large cities that provide the types of amenities that operations workers and their families enjoy. However, because of the varied dispersion of workers, these communities are able to absorb the increased population. Based on the distribution of residential communities in the area, the review team found *de minimis* impacts on other counties within a 50-mi radius in South Carolina and North Carolina.

5.4.1 Physical Impacts

This section identifies and assesses the direct physical impacts of operations-related activities on the community. The potential physical impacts of operating the proposed Lee Nuclear Station include disturbances from noise, odors, vehicle exhaust, dust, vibration, and visual intrusions. It includes consideration of impacts resulting from plant operations, transmission corridors and access roads, Make-Up Pond C, other offsite facilities, and project-related transportation of goods and materials in sufficient detail to predict and assess potential impacts and to show how these impacts should be treated in the licensing process. The review team concluded that these operations-related impacts will be mitigated through compliance with all applicable Federal, State, and local environmental regulations and, therefore will not significantly affect the region surrounding the site. The following sections assess the potential operations-related physical impacts of the proposed two nuclear units on specific segments of the population, the plant, and nearby communities.

5.4.1.1 Workers and the Local Public

No residences are located within the Lee Nuclear Station site boundary. The nearest resident is located 0.99 mi southeast of the proposed Unit 2 cooling tower (Duke 2013d). The 10-mi area around the Lee Nuclear Station site is predominantly rural and characterized by agricultural and forested land with an estimated 2007 total population of 43,132 (Duke 2009c). An estimated 620 ac of land will be inundated during construction for the development of Make-Up Pond C. No significant industrial or commercial facilities other than the Broad River Energy Center and Herbies Famous Fireworks exist within 5 mi of the Lee Nuclear Station site.

Noise

The proposed Lee Nuclear Station Units 1 and 2 will produce noise from the operation of pumps, cooling towers, transformers, turbines, generators, switchyard equipment, and loudspeakers (Duke 2009c). The noise levels would be controlled in accordance with applicable local regulations. Most equipment would be located inside structures, reducing the outdoor noise level. Duke will use two mechanical draft cooling towers for each unit to remove excess heat. Natural and mechanical draft cooling towers emit broadband noise, which Duke does not expect to be significantly greater than background levels (Duke 2009c). Noise levels below the 60 to 65 dBA day-night, 24-hour average (Ldn) range are considered to be of small significance (NRC 2013a). The maximum sound level generated by operation of proposed Lee Nuclear Station Units 1 and 2 at the site boundary will range from about 40 to 69 dBA, which would not affect the usage of nearby recreational areas and would not require mitigation. Therefore, the review team determined the noise-related effect on workers, nearby residents, and recreational users of nearby areas would be minimal, and no mitigation would be warranted. Traffic noise would be most noticeable during shift changes and during occasional periods of heavy truck traffic. Noise from heavy truck traffic could reach levels of 70 to 90 dBA at 50 ft from the road. Traffic can be minimized by enforcing low speed limits, maintaining good road conditions, and controlling the time of day peak site-related traffic occurs (Duke 2009c).

Air Quality

Once the proposed nuclear units have begun operation, they will not produce any known air pollutants except for (1) emissions from the periodic testing and operation of standby diesel generators and auxiliary power systems, (2) commuter vehicle dust and exhaust, and (3) odors from operations. Certificates to operate the diesel generators require that air emissions comply with all applicable regulations and operation of the generators would be intermittent and brief, therefore, the review team expects the air-quality impacts would be minimal. Access road maintenance and speed limit enforcement would reduce the amount of dust generated by the commuting workforce. Duke would use a staggered shift schedule for its operations workforce, which would also help mitigate the effects of vehicle exhaust (Duke 2009c). During normal plant operation, proposed Lee Nuclear Station Units 1 and 2 will not use chemicals in amounts that would generate odors exceeding Federal or State limits. Duke plans to use BMPs to control the odors emitted by chemicals and other sources during routine outages. Therefore, the review team estimates that the proposed Lee Nuclear Station Units 1 and 2 would have only minimal impact to air quality and would not require mitigation. Air-quality impacts of plant operation are discussed in more detail in Section 5.7 of this document.

5.4.1.2 Buildings

Approximately 86 housing units within the Make-Up Pond C site have been demolished during the development of Lee Nuclear Station Units 1 and 2. Onsite buildings would be built to safely withstand any possible impact, including shock and vibration, from operations activities associated with the proposed activity (Duke 2009c). Except for the Lee Nuclear Station structures, no other industrial, commercial, or residential structures will be affected.

5.4.1.3 Transportation

Roads within the vicinity of the Lee Nuclear Station site would experience an increase in traffic at the beginning and end of each operations shift and the beginning and end of each outage support shift. Commuter traffic will be controlled by speed limits. The access road to the Lee Nuclear Station site is paved. Maintaining good road conditions and enforcing appropriate speed limits will reduce the noise level and particulate matter generated by deliveries and the workforce commuting to and from the Lee Nuclear Station site. No new public roads would be constructed or be subject to major modifications due to the operation of proposed Lee Nuclear Station Units 1 and 2. Railroad deliveries during the operation phase would be less frequent than during construction. Therefore, the review team determined the road-related impacts from noise and dust to workers, residents, and other users of the roads within the vicinity of the proposed site would be minimal, and additional mitigation would not be warranted.

5.4.1.4 Aesthetics

The nearest residence is 0.99 mi southeast from the site of the proposed Lee Nuclear Station Units 1 and 2, separated by woodland and the Broad River such that the proposed Lee Nuclear Station Units 1 and 2 and associated structures may be visible. In addition, the proposed units and associated structures may be visible from the Broad River and residences along McKowns Mountain Road. The visual impacts would be from the reactor buildings and the cooling towers and their plumes, which will resemble cumulus clouds. Section 5.7 describes these impacts in more detail. Transmission lines are expected to be visible, but the corridors are located in predominately rural farmland. Make-Up Pond C will be visible from the road and local area. Plant-related structures would be visible only to those in close proximity of the site. Therefore, the review team expects the visual impact of the Lee Nuclear Station to be minimal and mitigation would not be warranted.

5.4.1.5 Summary of Physical Impacts

Based on the information provided by Duke, review team interviews with local public officials, and the review team's independent assessment of the physical impacts on workers and local public, buildings, transportation, and aesthetics, the review team concludes that the physical impacts of operation of the proposed Lee Nuclear Station Units 1 and 2 would be SMALL and additional mitigation measures beyond those discussed by Duke in its ER would not be warranted.

5.4.2 Demography

The baseline population of the two most local counties (Cherokee and York Counties) is estimated to increase steadily over the 40-year operating license similarly to population growth till 2035 (see Table 2-16). Duke projects an operations workforce of 957 operations workers, who would start arriving onsite during site development, as discussed in Section 4.4. Based on staffing at their other nuclear plants in the southeast, Duke estimates that 345 (36 percent) of the operations workforce would be highly specialized and would in-migrate into the area and that each in-migrating operations worker will bring a family. Duke expects the remaining new operations workforce, up to 612 workers (64 percent), would come from within the 50-mi region. Based on these assumptions, the review team assumes that impacts outside of Cherokee and York Counties would be minimal. Even if all 957 operations workers migrated into the area, they would constitute a less than 1 percent increase over the baseline population of Cherokee and York Counties. Therefore, the review team concludes that the demographic impact of operations workers on the local area would be minimal.

In addition to the operations workers, each new unit would require an outage workforce of 600 to 800 temporary employees who would be onsite for periods of approximately 30 days for scheduled refueling outages every 18 months (Duke 2009c). This means there would be an outage of one of the two new units approximately every 9 months. The review team expects that outage workers would typically migrate to the area from all over the country and stay only during the outage period at temporary lodging as close to the site as possible. The temporary nature of the work would generate only a minimal impact on Cherokee and York Counties, with little or no effects felt in the larger region. Based on information provided by Duke and the review team's independent review, the review team concludes that operations workers and their families would be expected to have a SMALL beneficial impact on the local communities and governmental entities in Cherokee and York Counties, and the 50-mi region.

5.4.3 Economic Impacts on the Community

The impacts of proposed Lee Nuclear Station Unit 1 and 2 operation on the local and regional economy are dependent on the region's current and projected economy and population. Although future impacts cannot be predicted with certainty, some insight can be obtained for the projected economy and population by consulting with county planners and population data. The primary economic impacts from operation of proposed Lee Nuclear Station Units 1 and 2 over the estimated 40-year operating license and employment of 957 new workers would be related to taxes, housing, and increased demand for goods and services, with the largest impact associated with plant property tax revenues (discussed in Section 5.4.3.2). The majority of economic impacts are expected to occur in the economic impact area of Cherokee and York Counties.

5.4.3.1 Economy

The review team estimated the potential social and economic impacts on the surrounding region as a result of operating proposed Lee Nuclear Station Units 1 and 2 and assuming a 40-year operating license. Social and economic impacts would occur from additional operation workforce jobs, wages paid, and tax revenue impacts during operation of the power plant.

Section 2.5 presents detailed descriptions of local and regional employment trends. The 957 new operations jobs at the proposed Lee Nuclear Station Units 1 and 2 would represent less than 1 percent of the total workforce in the economic impact area. However, in Cherokee County, where the nuclear power station is located, the additional 957 jobs represent approximately 4 percent of total employment. Cherokee County would be the most affected because it would likely receive the largest population and workforce increase as a percentage of its base population and workforce, and it would receive the substantial fee-in-lieu of tax payments (discussed in Section 5.4.3.2). Outside Cherokee County, the impacts become diffuse because of interactions with the larger economic base of the surrounding counties.

The employment of operations workers would have a multiplier effect in the local and regional economy, similar to that described in Section 4.4 for the building workforce. The applicable Regional Input-Output Modeling System (RIMS II) employment multiplier provided to Duke from the U.S. Department of Commerce Bureau of Economic Analysis is 2.165 (BEA 2011). This means that about 1115 indirect jobs would be supported by the Lee Nuclear Station operations in the economic impact area, increasing the total number of jobs supported to about 2072. The review team expects that only a minimal number of jobs would be created in the wider region. Because the review team expects that 36 percent of the operations workforce would migrate to the economic impact area, only 36 percent of the total employment effects would represent a net impact on the area. Employment effects representing upgraded employment for in-area workers also would count as impacts. However, the review team expects most of the operations workforce and associated indirect and induced employment would come from within the economic impact area. Therefore, the review team concludes that the new jobs would not increase the local baseline employment significantly. Because the indirect jobs typically would be service-related and not highly specialized, the review team expects that they would be filled primarily by residents of the region and would not induce new migration to the region.

Duke’s annual expenditures during operations are unknown; however, any expenditures made locally would represent a positive economic impact in the region as does spending of wages and salaries by operations workers. This represents new spending in the economic impact area. The new expenditures and income would result in an income multiplier impact felt in the economic impact area. The applicable income multiplier provided from RIMS II is 0.42 (BEA 2011). This means that for each dollar of new expenditure, 42 cents of new income is generated in the economic impact area.

The operation of the Lee Nuclear Station would also require an additional workforce needed for scheduled outages. Outages for Units 1 and 2 would be staggered, with each unit requiring an outage every 18 months. Each outage would require between 600 and 800 additional short-term contract employees to perform equipment maintenance, refueling, and special outage projects at the Lee Nuclear Station. Most of the outage workers would stay in local hotels, rent rooms in local homes, or bring travel trailers so they can stay as close as possible to the Lee Nuclear Station site. For nearby, existing nuclear plant outages, all hotel rooms in the area surrounding the plant are typically booked by outage workers. The review team expects the same for Cherokee County during the Lee Nuclear Station outages. Most hotels in Gaffney are also expected to be full during outages. This increases revenues for hotels, restaurants, and other retail establishments that provide services to these temporary workers. Outside Cherokee County, the impacts become more diffuse because of the area's larger economic base, with more available hotel rooms and temporary housing.

Based on information provided by Duke and the review team's own independent review, the review team concludes the overall impact on the economy of the region from operating the proposed Lee Nuclear Station would be positive. The most pronounced economic impacts would occur in Cherokee County, where impacts would be noticeable, and minimal beneficial economic impacts may occur in York County and other nearby counties within commuting distance of the site.

5.4.3.2 Taxes

The tax structure of the region is discussed in Section 2.5. Several types of taxes would be generated during the operational life of proposed Lee Nuclear Station Units 1 and 2. Employees would pay sales, use, personal property, and income taxes, and vendors selling materials and services to the facility would pay a variety of State, Federal, and local taxes. The Lee Nuclear Station site would be subject to property taxes paid to Cherokee County.

Sales, Use, Income, and Corporate Taxes

Duke will pay $3 per $1000 of gross receipts derived from services rendered each year. Based on an average customer cost for electricity in 2007 for South Carolina of $0.0695/kWh and an annual electricity generation of 18,200,000 MW(h), Duke will pay over $3.5 million annually (Duke 2009c). To the extent the new operations employees will move into the area surrounding the proposed site from other areas, or currently unemployed persons living in the state become employed at the plant, the counties within the 50-mi radius of the Lee Nuclear Station site in South Carolina and North Carolina will experience an increase in sales tax, use tax, and income tax revenues; however, a majority of these tax payments go to the general state funds, so tax revenue impact at the regional level would be negligible.

Property Taxes

Property taxes on the plant accrue to Cherokee County. Duke is expected to make fee-in-lieu of tax payments to the county rather than paying property taxes, as discussed in Section 2.5.2.2. Duke's agreement with Cherokee County allows the in-lieu of taxes assessment to drop to 2 percent as long as the project investment reaches $2 billion. Duke expects the cost of proposed Lee Nuclear Station Units 1 and 2 to be approximately $11 billion. Because different classes of property are taxed at different rates, Duke expects its rate to be $11.8 million/yr for 30 years as a part of the Infrastructure Tax Credit Agreement between Duke and Cherokee County (Duke 2009c). Duke's fee-in-lieu payments will represent more than a 20 percent increase in total Cherokee County property tax and fee-in-lieu revenues.

In addition to the fee-in-lieu of tax payments on the Lee Nuclear Station, the region could experience an increase in property tax revenues on new homes if the influx of workers results in any new residential construction and/or increases in existing home prices. This overall impact would likely be minimal, because operation workers and their families would only make up a small percentage of the existing population in the region. The beneficial tax impacts would be expected to be significant for Cherokee County and minimal for York County and the rest of the region.

5.4.3.3 Summary of Economic Impacts on the Community

Based on the information provided by Duke, the review team's interviews with local public officials, and the review team's independent review of data on the regional economy and taxes, the review team concludes that the regional economic impacts of operating proposed Lee Nuclear Station Units 1 and 2 would be SMALL beneficial for all counties except Cherokee County, which would experience a LARGE beneficial impact under South Carolina tax law.

5.4.4 Infrastructure and Community Services Impacts

Infrastructure and community services include transportation, recreation, housing, public services, and education. Operation of the proposed Lee Nuclear Station Units 1 and 2 would impact the transportation network due to additional workforce using local roads to commute and the possibility of truck deliveries being made in support of plant operations. These same commuters could also potentially impact recreation in the area. As the workforce migrates into and settles in the region, housing, education, and public sector services may be affected. While the review team realizes that 112 of these workers will be onsite during peak construction, the following analysis is based on 957 workers to get an accurate assessment of the impact of operations of the proposed Lee Nuclear Station Units 1 and 2 on infrastructure and community services.

5.4.4.1 Traffic

Similar to the discussion in Section 4.4.4, the impacts of Lee Nuclear Station operations on transportation and traffic would be greatest on the roads of Cherokee County, particularly McKowns Mountain Road, a two-lane road that provides the only access to the site. Beyond McKowns Mountain Road, traffic is disbursed in several directions. Capacity improvements to roads during construction between Interstate 85 and the site would remain in place with the exception of traffic signals on McKowns Mountain Road.

As discussed in Section 4.4.4, the review team assumed current traffic on McKowns Mountain Road is 950 vehicles a day. The capacity for McKowns Mountain Road is 1700 vehicles per hour for each direction and 3200 vehicles per hour for both directions. The Lee Nuclear Station will operate five shifts on a rotating schedule. The shifts will include an 8-hour day 5 days a week, two 10-hour day 4 days a week shifts, and two 12-hour shifts with 3 days on and 3 days off (Duke 2009c). Thus, there is enough capacity for the additional cars attributed to operations at Lee Nuclear Station. During outages, there could be as many as 800 additional workers, increasing traffic and adding congestion on McKowns Mountain Road; however, the staggered shifts make it unlikely that road capacities will be exceeded. Therefore, the operations-related impacts on traffic would be minimal.

5.4.4.2 Recreation

A detailed description of local tourism and recreation is provided in Section 2.5.2.4. The primary impacts on recreation would be similar to but smaller than those described for building proposed Lee Nuclear Station Units 1 and 2 in Section 4.4.4.2. No recreational activities will be allowed within the Make-Up Pond C site. The review team expects impacts on recreation within a 50-mi radius of the Lee Nuclear Station site to be minimal. The aesthetic impacts of the plant operations from the vantage point of local recreational areas would be minimal.

5.4.4.3 Housing

Regional housing characteristics and availability are described in Section 2.5.2.5. The closest cities to the Lee Nuclear Station site are Gaffney and Blacksburg; however, larger economic centers such as Spartanburg, Rock Hill, and Charlotte are all within commuting distance. The review team expects the majority of operations workers to come from within the region, and consequently, they would not represent new net demand for housing. Approximately 36 percent of the operations workforce or 345 workers are expected to in-migrate. The review team expects the largest impacts on housing to occur in Cherokee and York Counties; however, given the relatively small operations workforce compared to the larger construction workforce the operations workers would be easily absorbed by the local communities. The Lee Nuclear Station would need as many as 800 additional workers for 3 to 5 weeks staggered every 18 months during each maintenance outage of the two reactors. It is expected the majority of workers would stay in hotels or trailers, or rent rooms in homes, and would not become permanent residents in the region. This influx of temporary workers would not be expected to impact the permanent housing stock or housing market in the region.

Operation of Lee Nuclear Station could affect housing values in the vicinity of the Lee Nuclear Station site. In a review of previous studies on the effect of seven nuclear power facilities, including four nuclear power plants, on property values in surrounding communities, Bezdek and Wendling (2006) concluded that assessed valuations and median housing prices have tended to increase at rates above national and State averages. Clark et al. (1997) similarly found that housing prices in the immediate vicinity of two nuclear power plants in California were not affected by any negative imagery of the facilities. These findings differ from studies that looked at undesirable facilities, largely related to hazardous waste sites and landfills, but also including several studies on power facilities (Farber 1998) in which property values were negatively affected in the short term, but these effects were moderated over time. Bezdek and Wendling (2006) attributed the increase in housing prices to benefits provided to the community in terms of employment and tax revenues, with surplus tax revenues encouraging other private development in the area. Given the findings from the studies discussed above, the review team determines that the impact on housing and housing value from the operations of the Lee Nuclear Station would be minor.

5.4.4.4 Public Services

This section describes the available public services and discusses the impacts of the operation of the proposed Lee Nuclear Station Units 1 and 2 on water supply and waste treatment; police, fire-protection, and medical services; education; and social services in the region.

Water Supply Facilities

Section 2.5.2.6 describes the water-supply systems and facilities in the vicinity of the Lee Nuclear Station site. The Lee Nuclear Station site would use potable water from the Draytonville water system, which is supplied by the Victor Gaffney Plant and the Cherokee Plant. Municipal water suppliers in Cherokee County have an excess capacity (see Table 2-24) of approximately 10 Mgd. As discussed in Section 4.4.4.4, the local water systems in Cherokee and York Counties are expected to be able to meet the demand for water from the peak population during development of the Lee Nuclear Station site. Therefore, because the planned operations workforce is considerably smaller than the building workforce, the review team expects local water systems would have no difficulty meeting water demand during the operations phase. Therefore, the review team expects the impacts on the water supply would be minimal, and additional mitigation would not be warranted.

Wastewater Treatment Facilities

Section 2.5.2.6 describes the public wastewater treatment systems in Cherokee and York Counties, their permitted capacities, and current demands. Currently, wastewater-treatment facilities have excess capacity (see Table 2-24). The Lee Nuclear Station site will use the Broad River Wastewater Treatment Plant for wastewater needs. Any upgrades to the wastewater facility needed to support building the units would be completed before or during the building of proposed Lee Nuclear Station Units 1 and 2. As discussed in Section 4.4.4.4, the local wastewater systems in Cherokee and York Counties are expected to be able to meet the demand for water from the peak population during the building phase. Therefore, because the planned operations workforce is considerably smaller than the building workforce, the review team expects local water systems would have no difficulty meeting water demand during the operations phase. Therefore, the review team concludes the impact on wastewater treatment from the in-migration of operations workers and their families would be minimal, and mitigation would not be warranted.

Police and Fire Services

Based on analysis provided in Section 2.5.2.6, the review team expects that current levels of law enforcement and fire-protection personnel would be adequate to meet the need of the communities throughout the building phase, as discussed in Section 4.4.2. The review team expects the increase in population for any given county to be less than 1 percent (Section 5.4.2), the impact of new operations workers and their families on police and fire services would be well within the expected population growth planned by the local governments. Even without adding capacity during the building phase, the impact on law enforcement and firefighting services from the operation of proposed Lee Nuclear Units 1 and 2 would not be significant.

Medical, Health, and Human Services

Section 2.5.2.6 describes the level of medical and human services within Cherokee and York Counties, which the review team determined is sufficient to absorb the building-related influx of workers and therefore, could support the smaller operations-related influx of workers. New jobs created to operate and maintain proposed Lee Nuclear Station Units 1 and 2 would benefit the disadvantaged population served by the State health and human resources offices by adding jobs to the region that may go to individuals currently underemployed or unemployed, removing them from social services client lists. While the influx of new workers and their families may also create additional pressure on those same social services, the review team concludes that the net effect of the new permanent operations workforce on local and State health and human services would be minimal.

5.4.4.5 Education

Section 5.4.2 discusses the review team's underlying assumptions about the distribution of workers' families within the 50-mi radius around the proposed site. These assumptions indicate the expected increase in population for any given county within the analytical area would be less than 1 percent. This rate is well within the planned growth rate for each county government. Because there would be relatively few new students coming from the families of operations workers, the review team believes the impact of plant operations on public schools would be minimal. The review team expects that school-age children typically would not accompany temporary outage workers in-migrating into the area to work at the Lee Nuclear Station site.

As discussed in Section 2.5.2.7, both Cherokee and York County District One school districts are undergoing renovations and have room for the extra students that migrate into the region. Furthermore, officials from both districts stated that accommodating new students from the operations workforce would not be a problem (NRC and PNNL 2008).

5.4.4.6 Summary of Infrastructure and Community Services Impacts

The review team has reviewed information provided by Duke, visited the site and its environs, and performed its own independent review of potential infrastructure and community services impacts of operations on the local area and region of the Lee Nuclear Station site. In all cases, the compelling argument in support of the review team's conclusions is that the operations workforce would be considerably smaller than the building peak employment. Therefore, any impacts derived from operations must necessarily be less than the same impact derived from peak building activities. The review team concludes that expected operations impacts on transportation, recreation, housing, public services, and education would be SMALL and require no mitigation.

5.5 Environmental Justice

Environmental justice refers to a Federal policy under which each Federal agency identifies and addresses any disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority or low-income populations. On August 24, 2004, the Commission issued its policy statement on the treatment of environmental justice matters in licensing actions (69 FR 52040). Section 2.6 discusses the locations of minority and low-income populations near the Lee Nuclear Station site and within the 50-mi radius.

The scope of the review, as defined in NRC guidance (NRC 2001, 2004a; 69 FR 52040), should include an analysis of the impacts on minority and low-income populations, the location and significance of any environmental impacts during operations on populations that are particularly sensitive, and any additional information pertaining to mitigation. The descriptions to be provided by this review should include whether the impacts are likely to be disproportionately high and adverse. The review should evaluate the significance of such impacts.

The review team evaluated whether the health or welfare of minority and low-income populations at those census blocks identified in Section 2.6 of this EIS could experience disproportionately high and adverse impacts from operating two nuclear units at the proposed Lee Nuclear Station. To perform this assessment, the review team used the same process employed in Section 4.5.

The nearest minority or low-income populations of interest identified are located in the Gaffney, South Carolina city limits. Gaffney is approximately 8 mi northwest of the Lee Nuclear Station site.

5.5.1 Health Impacts

For all three health-related considerations described in Section 2.6.1, the review team determined through literature searches and consultations with NRC staff health experts that the expected operations-related level of environmental emissions is well below the protection levels established by NRC and EPA regulations and would not impose a disproportionately high and adverse effect on minority or low-income populations. The results of the normal operation dose assessments (Section 5.9) indicate that the maximum individual dose for these pathways would be insignificant, well below the regulatory guidelines in Appendix I of 10 CFR Part 50 and the regulatory standards of 10 CFR Part 20. As discussed in Section 4.5.1 in the context of building activities, there is no evidence that radiological or nonradiological effects from operations affect any demographic subgroup differently from any other subgroup. Furthermore, as discussed in Section 2.6, the review team did not identify any evidence of unique characteristics or practices in the minority and low-income populations that may result in different health pathway impacts compared to the general population. Therefore, the review team concluded that there would be no disproportionately high and adverse health impacts on minority and low-income members of the public from the release of radiological material from operations or from design basis accidents. The health-related environmental justice impacts derived from operating the proposed Lee Nuclear Station would be SMALL.

5.5.2 Physical and Environmental Impacts

There are four primary pathways in the environment: soil, water, air, and noise. The following four subsections discuss each of these pathways in greater detail.

5.5.2.1 Soil-Related Impacts

As discussed in Section 5.8, the review team does not expect operations-related environmental impacts on soils at the Lee Nuclear Station site that would affect nearby residents, and there are no residents onsite. Because soil impacts attenuate rapidly with distance, the review team expects that there would not be soil-related disproportionately high and adverse impact on minority or low-income populations. Land-use impacts in the transmission-line corridors and on the Make-Up Pond C site from operation of proposed Lee Nuclear Station Units 1 and 2 would be minimal and are not expected to have adverse effects on the population. In addition, as discussed in Section 2.6.3 of this EIS, the review team did not identify evidence of unique characteristics or practices that may result in different soil-related impacts compared to the general population. Based on information from Duke and the review team's own independent review, the review team concludes that the operations-related impact from pathways related to soils from the Lee Nuclear Station would not impose disproportionately high and adverse impacts on minority or low-income populations.

5.5.2.2 Water-Related Impacts

As discussed in Section 5.2, the review team determined that operating the proposed Lee Nuclear Station Units 1 and 2 would create a volume of cooling-tower blowdown that would not be significant when compared to the river flow and would comply with applicable State water-quality standards. Plant effluent discharges would be regulated and monitored, and additional mitigation would not be warranted. As discussed in Section 2.6.3 of this EIS, the review team found evidence of some subsistence fishing in the site vicinity, but did not identify an operational pathway that could result in different water-related impacts compared to the general population. The review team did not identify evidence of unique characteristics or practices in minority or low-income populations that may result in different water-related impacts compared to the general population. Therefore, the review team expects no disproportionately high and adverse impacts on identified minority or low-income populations.

Based on Section 5.2, the review team concludes that water use at the Lee Nuclear Station site would have little or no effect on the availability of water for other uses. Based on Section 5.3.2, the water use at the Lee Nuclear Station site would have minimal impacts on the fish population of Ninety-Nine Islands Reservoir or the Broad River. Therefore, the impacts would not warrant mitigation or cause a disproportionately high and adverse impact on identified minority or low-income populations.

Based on information from Duke and the review team's independent evaluation, the review team concludes that given the relatively minimal impact on water quantity and quality in Ninety-Nine Islands Reservoir and the Broad River, and the small consumptive water use of the proposed Lee Nuclear Station Units 1 and 2, there would be no operations-related disproportionately high and adverse environmental impacts on minority or low-income populations.

5.5.2.3 Air-Quality-Related Impacts

As discussed in Section 5.9, the total liquid and gaseous effluent doses from the new units would be well within the regulatory limits of the NRC and EPA, implying that impacts on any population are likely to be minimal from this source. The primary air emissions from a nuclear power plant (e.g., proposed Lee Nuclear Station Units 1 and 2) are water vapor and salt, which do not pose health dangers to the general public. In addition, air-quality impacts attenuate rapidly with distance from the source. The review team concluded in Section 5.7 of this EIS that the potential impacts from nonradiological sources of air emissions would be SMALL. Furthermore, the review team believes that because of the distance between the Lee Nuclear Station site and minority or low-income populations, any airborne pollutants emanating from proposed Lee Nuclear Station Units 1 and 2 would rapidly disperse to near background levels. The review team did not identify any evidence of unique characteristics or practices that may result in different air-quality-related impacts compared to the general population. Given that the total effluent doses from the new units would be well within regulatory limits and given that airborne pollutants released from the new units would rapidly disperse to near background levels, the review team concludes that the potential impacts from operations-related sources of radiological and nonradiological air emissions would not result in disproportionately high and adverse impacts on minority or low-income populations within the site vicinity.

5.5.2.4 Noise Impacts

As discussed in Section 5.4.1 and 5.8.2, primary noise sources associated with operation of Lee Nuclear Station Units 1 and 2 are pumps, cooling towers, transformers, turbines, generators, switchyard equipment, and loudspeakers. As analyzed in Section 5.8.2, the overall projected combined ambient and cooling-tower noise levels range from approximately 48 to 64 dBA. Noise from corona discharge along proposed transmission lines is expected to be less than 10 dBA (Duke 2009c). According to NUREG-1437 (NRC 2013a), noise levels below 60 to 65 dBA are considered to be of small significance. Therefore, the review team determines there is no noise-related pathway by which minority or low-income populations of interest could receive a disproportionately high and adverse impact.

5.5.3 Socioeconomic Impacts

Socioeconomic impacts were concluded to be SMALL in Section 5.4. The review team determined that once the proposed Lee Nuclear Station Units 1 and 2 are operational, any adverse socioeconomic impacts felt by any group within the region of interest would either stop or significantly diminish when the construction workforce leaves the region. However, offsetting the departure of the construction workforce would be the in-migration of the permanent workforce that would operate and maintain Lee Nuclear Station Units 1 and 2. While the addition of these new employees would place pressure on local infrastructures (e.g., schools and hospitals), the review team believes any adverse impact the in-migration might create would be overwhelmed by the positive contributions of that workforce to their new local communities through income, taxes, and fee-in-lieu of tax payments. Furthermore, the review team's interviews of surrounding communities revealed a high level of preparedness with regard to any potential influx of temporary construction or permanent operations workers.

5.5.4 Subsistence and Special Conditions

NRC's environmental justice methodology includes an assessment of populations of particular interest or unusual circumstances, such as minority communities exceptionally dependent on subsistence resources or identifiable in compact locations, such as Native American settlements. As part of its visits to the site and region, the review team interviewed public officials and community leaders of the local minority populations in relation to subsistence practices (Niemeyer 2008). The review team heard anecdotal information about local subsistence fishing in York County, South Carolina from one person. The discussion gave anecdotal evidence of isolated subsistence fishing in ponds, streams, and Lake Wiley in York County.

The review team reviewed this account, but determined that there is no potential for disproportionately high and adverse operational impacts related to subsistence activities on environmental justice populations. The potential radiological releases from the proposed Lee Nuclear Station Units 1 and 2 would be well below regulatory limits. Because adverse radiological or nonradiological health impacts from the operation of the new units are not expected (see Sections 5.8 and 5.9), potential subsistence fishing activities in York County, Ninety-Nine Islands Reservoir, or the Broad River would not have either a radiological or nonradiological adverse health effect. The review team also determined that the impacts from chemical discharges to the Broad River would be minimal (see Section 5.3.2), and no additional mitigation would be warranted. Therefore, minority or low-income individuals who may be engaged in subsistence fishing would not experience disproportionately high and adverse impacts.

No other unique characteristics or practices were identified by the review team for the low-income and minority populations that would indicate a dependence on subsistence resources that would be impacted by operation of the proposed Lee Nuclear Station Units 1 and 2.

5.5.5 Summary of Environmental Justice Impacts

As discussed in Section 2.6.1, the review team identified several census blocks that meet the criteria for minority populations within the site region. The review team determined these areas may have a greater potential for disproportionately high and adverse operations impacts on minority and low-income populations. Consequently, the review team further analyzed these areas of potential impacts to determine whether or not such impacts would be significant.

Based on information provided by Duke and review team interviews conducted with public officials in surrounding counties concerning the potential for environmental pathways and unique characteristics or practices, the review team determined there would be no disproportionately high and adverse impact on any minority or low-income populations.

Therefore, the review team determined the operations-related environmental justice impacts of proposed Lee Nuclear Station Units 1 and 2 would be SMALL.

5.6 Historic and Cultural Resources Impacts

The National Environmental Policy Act of 1969, as amended (NEPA) requires Federal agencies to take into account the potential effects of their undertakings on the cultural environment, which includes archaeological sites, historic buildings, and traditional places important to interested parties. The National Historic Preservation Act of 1966, as amended (NHPA) also requires Federal agencies to consider impacts to those resources if they are eligible for listing on the National Register of Historic Places (National Register). Such resources are referred to as "historic properties" in the National Register. As outlined in 36 CFR 800.8, "Coordination with the National Environmental Policy Act of 1969," the NRC and the USACE are coordinating compliance with Section 106 of the NHPA in fulfilling their responsibilities under NEPA.

Operation of new nuclear power plants can affect either known or undiscovered historic and cultural resources. In accordance with the provisions of NHPA and NEPA, the NRC and the USACE, a cooperating Federal agency, are required to make a reasonable and good faith effort to identify historic properties and cultural resources in the project areas of potential effect (APEs) and, if present, determine if any significant impacts are likely. Identification is to occur in consultation with the appropriate State Historic Preservation Officer (SHPO), American Indian Tribes, interested parties, and the public. If significant impacts are possible, efforts should be made to mitigate them. As part of the NEPA/NHPA integration, even if no historic properties or important cultural resources are present or affected, the NRC and the USACE are still required to notify the appropriate SHPO before proceeding. If it is determined that historic properties or important cultural resources are present, efforts must be made to assess and resolve any adverse effects of the undertaking.

The review team does not expect any significant or adverse impacts on historic properties or important cultural resources during the operation of the proposed Lee Nuclear Station. A detailed discussion of historic and cultural resources at the Lee Nuclear Station site is included in Section 2.7. As explained, archaeological and architectural surveys have been conducted for direct (physical) and indirect (visual) APEs within the Lee Nuclear Station site and vicinity as well as offsite areas by qualified professional cultural resources contractors and potential effects have been considered for a number of historic properties and cultural resources. As part of these investigations, Duke has established ongoing communications with the South Carolina SHPO and has shared information with four Federally recognized American Indian Tribes and four Native American organizations (Duke 2008f, g, 2009c, h, j, 2010i, j). Based on responses received from three interested American Indian Tribes, Duke has established ongoing communications with the Catawba Indian Nation, the Eastern Band of Cherokee Indians, and the Seminole Tribe of Florida. The NRC also has also invited these Tribes and other tribal organizations, the South Carolina SHPO, and the Advisory Council on Historic Preservation to participate in the initial and supplemental scoping processes for the environmental review and invited their feedback on the draft EIS (Appendices C and F). Consultation between the USACE, Duke, the South Carolina SHPO, and interested Tribes has resulted in a final cultural resources management plan and Memorandum of Agreement (MOA) for the Lee Nuclear Station site and associated developments (USACE et al. 2013).

Largely in response to concerns expressed by the aforementioned consulting parties, Duke Energy has developed a corporate policy to minimize impacts to sites, landmarks, and/or artifacts of potential cultural or archaeological importance that includes specific provisions for the protection of cultural resources at all facilities owned and operated by Duke and its employees and contractors as well as procedures for handling any inadvertent cultural resources discoveries in coordination with the South Carolina SHPO and Tribal Historic Preservation Officer(s) (THPOs), as appropriate (Duke 2009b). Throughout the consultation process and information exchange, the South Carolina SHPO has repeatedly requested that an agreement be developed to "… govern future cultural resources identification and address future work to be done at the plant through the life of the license." (Duke 2010n). In 2013, Duke, the USACE, the South Carolina SHPO, and the Catawba Indian Nation THPO finalized a cultural resources management plan and associated MOA tailored specifically to proposed Lee Nuclear Station site and associated developments (USACE et al. 2013).

Operational activities associated with proposed Lee Nuclear Station Units 1 and 2 will occur primarily within the 1900-ac area that constitutes the onsite direct, physical APE. Visual impacts associated with tall structures such as the proposed nuclear units and associated containment buildings and the meteorological tower as well as the temporary effects of operational noise and vapor fumes associated with operating plant components may extend beyond the 1900-ac area to an indirect, visual APE that is defined as the zone within approximately 1 mi of these structures and plumes. As summarized in Section 2.7, periodic cultural resources investigations spanning the past four decades within the 1900-ac Lee Nuclear Station site have resulted in the documentation of 18 archaeological sites and four historic cemeteries. Six of these resources, which were originally evaluated as non-significant by investigators and thus not likely to have been eligible for National Register nomination, were heavily disturbed during original site-preparation activities associated with the former Cherokee Nuclear Station. The remaining archaeological sites identified in current APEs have been determined ineligible for nomination to the National Register in coordination and consultation with the South Carolina SHPO (Duke 2009c; SCDAH 2007b, 2009a, 2012a, 2013). The Eastern Band of Cherokee Indians also concurred with these findings (EBCI 2011).

Cultural resources investigations within the larger onsite indirect, visual APE have resulted in the documentation of the four previously mentioned historic cemeteries as well as 13 architectural resources (Brockington 2007a, b, 2009a). One of these resources, Ninety-Nine Islands Dam and Ninety-Nine Islands Hydroelectric Project, is a National Register-eligible historic property. The remainder have been determined ineligible for nomination to the National Register in consultation with the South Carolina SHPO, and no effects are anticipated (SCDAH 2007b, 2009a, 2012a, 2013). Consultation with the South Carolina SHPO has resulted in a determination that there will be no adverse effects to Ninety-Nine Islands Dam and Hydroelectric Project because the operational components of proposed Lee Nuclear Station Unit 1 and 2 and other onsite developments have been determined to be consistent with the industrial theme of the historic properties and they will not alter the characteristics of the dam and powerhouse that make them historically significant. In this context, the South Carolina SHPO concurs that no adverse effects will occur to the unique design, workmanship, or materials of the dam and plant and their role in the history of hydropower development in the Piedmont region of South Carolina will be unaffected (SCDAH 2007b, 2009a, 2012a).

Four historic cemeteries are located within the 1900-ac Lee Nuclear Station site. Although these resources are not eligible for nomination to the National Register, they are protected by State law and continue to be culturally important to local members of the community as indicated by ongoing periodic requests for access (Duke 2010d). The South Carolina SHPO also has recommended protection (SCDAH 2012a). Duke has added these resources as a spatial layer in the Lee Nuclear Station site GIS for overall management and protection and intends to continue to maintain surrounding fences and provide public access. Any future maintenance will be completed in coordination with the South Carolina SHPO and according to the Lee Nuclear Station site cultural resources management plan and associated MOA (USACE et al. 2013). Operational activities will not prevent visitor access to these resources or cause direct physical impacts, and visual effects are unlikely due to their locations in wooded areas far from proposed plant components (Duke 2009c). No traditional cultural places of importance to interested American Indian Tribes have been identified at the Lee Nuclear Station site.

Operations at the proposed Lee Nuclear Station Units 1 and 2 during drought conditions may require drawdown and refill of proposed Make-Up Pond C. Cultural resources investigations of Make-Up Pond C and associated developments were focused on APEs defined in coordination with the South Carolina SHPO as a 620-ac reservoir with a 300-ft shoreline buffer and associated developments such as water lines, spillways, spoil and laydown areas (direct APE) and a 1.25-mi zone surrounding this area to encompass potential visual intrusions (indirect APE). The investigations resulted in the assessment of 13 archaeological sites, two historic cemeteries, 28 architectural resources, and one possible historic district. All of these resources were recommended not eligible for National Register nomination, leading to a finding of no historic properties affected for Make-Up Pond C and associated developments (Brockington 2009b, 2010, 2011, 2013). However, the historic cemeteries were identified as significant cultural resources, protected under South Carolina State law (South Carolina Code of Laws Title 16-Crimes and Offenses, Chapter 17-Offenses Against Public Policy, Article 7-Miscellaneous Offenses, Section 16-17-600, and Title 27-Property and Conveyances, Chapter 43-Cemeteries, Article 1, Sections 27-43-10 through 27-43-30, 27-43-40, and 27-43-310, summary also found in CSCPA 2005) and recommended for protection by the South Carolina SHPO (SCDAH 2012a).

No impacts were expected at the McKown Family Cemetery, but the Service Family Cemetery was recommended for relocation in advance of ground-disturbing project activities. The South Carolina SHPO concurred with the finding of no historic properties affected and recommendations for relocation of the Service Family Cemetery (SCDAH 2009b, 2010a, 2011, 2012a, 2013). The Eastern Band of Cherokee Indians and Seminole Tribe of Florida also submitted no objections to the findings (EBCI 2010a, b, 2011; STF 2009, 2010).

During operations, Make-Up Pond C will be used to supply supplemental water for plant operations on an as-needed basis (Duke 2009b). Because no National Register-eligible archaeological or architectural resources are located in the direct or indirect APEs for the new reservoir and the culturally important Service Family Cemetery will be moved to another location prior to ground disturbance and inundation, no impacts to historic properties or cultural resources are anticipated from the process of drawing down and refilling the new reservoir.

During operation of the Lee Nuclear Station, Duke also intends to conduct parallel and related operations at offsite developments including reactivation and use of the existing railroad line and operation and maintenance of two proposed offsite transmission lines (Routes K and O). As discussed in Section 2.7 and summarized below, in coordination with the South Carolina SHPO, Duke has completed specific cultural resources investigations of direct, physical APEs and corresponding indirect, visual APEs for preconstruction of these offsite developments (Brockington 2007c, 2009b, 2010; ACC 2009).

Reactivation and use of the existing railroad line will be limited to locomotive traffic and maintenance of the rails, the railroad bed, and other equipment (Duke 2009c). None of these activities will extend outside the disturbed railroad corridor to cause impacts to any identified cultural resources. This includes one National Register-listed property, Ellen Furnace Works (38CK68), which is located on both sides of the disturbed railroad line (Brockington 2007c). The South Carolina SHPO has concurred with the evaluation that none of the significant cultural features or deposits associated with this historic property are present in the rail corridor, and no adverse effects are anticipated (SCDAH 2008, 2012a).

Cultural resources investigations of the proposed routes for two new offsite transmission lines resulted in the documentation of 37 archaeological sites in the direct, physical APEs (ACC 2009). In consultation with the South Carolina SHPO, all of these sites were determined ineligible for nomination to the National Register due to low potential for future research and a finding of no historic properties (archaeological in nature) was concluded (SCDAH 2009c). One of the identified archaeological sites was identified as a possible human burial site (38CK172), and although it is not eligible for National Register nomination, it is potentially subject to consideration under State and Federal burial laws (summary in CSCPA 2005). This site also remains a culturally important resource as indicated by feedback from the Eastern Band of Cherokee Indians requesting protection of the possible burial (EBCI 2009). Duke has confirmed that sensitive cultural resources like 38CK172 will be considered during all phases of transmission-line design, installation, operation, and maintenance through inclusion of these resources in project GIS maps and establishment of protective 50-ft radius buffers where no towers or poles will be placed and vegetation will be cleared by hand, both initially and during subsequent maintenance (Duke 2010t). Periodic required inspections of the lines also will be completed by aircraft, eliminating the need for new roads to support access and egress (Duke 2010q). These mitigations are summarized in the cultural resources management plan and MOA for the Lee Nuclear Station site and associated offsite developments (USACE et al. 2013), so operation and maintenance of the new transmission lines should result in no significant impacts to 38CK172. No additional resources of tribal concern have been identified within transmission-line APEs or any other onsite or offsite APEs (EBCI 2011).

In 2009, 39 architectural resources were identified within the indirect APE for the offsite transmission lines in a zone extending 0.5 mi from the proposed centerlines. Nine of these resources, including the National Register-eligible Ninety-Nine Islands Dam and Hydroelectric Project, also are co-located in the indirect APE for the Lee Nuclear Station site. As summarized in Section 2.7, most of the architectural properties identified are twentieth-century residences unlikely to yield any additional important information and evaluated as ineligible for National Register nomination (ACC 2009). However, three National Register-eligible properties were documented: Ninety-Nine Islands Dam and Hydroelectric Project, important for its association with early development of hydropower in the region; and two historic farmsteads (Smith's Ford Farm and Reid-Walker-Johnson Farm), important for their association with historic settlement and agricultural economies of the mid-eighteenth and early twentieth centuries. Investigators concluded that the new transmission lines would have no effect on Ninety-Nine Islands Dam and Hydroelectric Project properties given their historic association with power generation and transmission (ACC 2009). Analyses of potential visual impacts to the historic farmsteads demonstrated that distance, topography, and vegetation cover will screen these properties from significant visual modifications in their respective viewsheds (Pike Electric 2010). The South Carolina SHPO concurred that the proposed transmission lines will cause no adverse effects to the two historic farmsteads and no effects on any other historic properties (SCDAH 2009c, 2010b, 2012a). Operation and maintenance of the new transmission lines are not likely to cause any additional visual impacts to these resources.

To develop the impact assessments presented here, the review team

- analyzed the potential impacts to historic properties and cultural resources resulting from operational activities in onsite and offsite areas as described in the ER, Make-Up Pond C supplement to the ER, 2013 supplemental information related to site design changes, and cultural resources survey reports

- confirmed Duke Energy's corporate policy for cultural resources consideration and protection at all facilities owned and operated by Duke Energy and the inclusion of inadvertent discovery procedures therein
- considered Duke's past and ongoing coordination with the South Carolina SHPO and American Indian Tribes that have expressed interest in the proposed activities
- reviewed the final cultural resources management plan and associated MOA between Duke, the USACE, the South Carolina SHPO, and the Catawba Indian Nation THPO that formalizes continued consideration of cultural resources at the Lee Nuclear Station site and associated developments (USACE et al. 2013).

For purposes of NHPA Section 106 consultation, the review team does not anticipate any adverse effects to historic properties during the operation of proposed Lee Nuclear Station Units 1 or 2 or parallel and related operations of additional onsite developments, proposed Make-Up Pond C, the offsite railroad line, or two new transmission lines based on (1) a review of the final cultural resources management plan and associated MOA for the Lee Nuclear Station site (USACE et al. 2013), (2) implementation of Duke Energy's corporate policy for continued cultural resources consideration and protection, and (3) inadvertent discovery procedures to ensure that sensitive resources are adequately considered and protected as necessary.

For the purposes of the NEPA analysis, the review team does not expect any significant impacts to historic and cultural resources during operation of proposed Lee Nuclear Station Units 1 and 2 or parallel and related operations of additional onsite developments, proposed Make-Up Pond C, the offsite railroad line, or two new transmission lines based on (1) Duke's successful completion of plans to relocate the Service Family Cemetery and protect the possible human burial site (38CK172) and (2) Duke's commitment to implement the corporate policy for cultural resources consideration and protection at all facilities owned and operated by Duke Energy, its employees and contractors, and associated procedures should cultural resources be inadvertently discovered during ground-disturbing activities. With the corporate procedure consistently implemented by the cultural resources management plan and MOA among Duke, the USACE, the South Carolina SHPO, and the Catawba Indian Nation THPO and tailored specifically for the Lee Nuclear Station site and associated developments (USACE et al. 2013), the review team concludes that the impacts on historic and cultural resources from operations would be SMALL.

5.7 Meteorological and Air-Quality Impacts

The primary impacts of operation of proposed Lee Nuclear Station Units 1 and 2 on local meteorology and air quality would be from releases to the environment of heat and moisture from the mechanical draft cooling towers, emissions from operation of auxiliary equipment (e.g., generators and boilers), and emissions from workers' vehicles. The potential impacts of releases from operation of the cooling system are discussed in Section 5.7.1. Section 5.7.2 addresses potential air-quality impacts from nonradioactive effluent releases at the Lee Nuclear Station site, and Section 5.7.3 addresses the potential air-quality impacts of transmission-line corridors during operation.

5.7.1 Cooling-System Impacts

Each of the proposed Lee Nuclear Station Units 1 and 2 are designed to use a set of two circular mechanical draft cooling towers for the main CWS (Duke 2012g). In addition, each unit will have one mechanical draft cooling tower for the SWS (Duke 2009c). Chapter 3 of the EIS provides the site layout and plant description in detail.

Mechanical draft cooling towers remove excess heat by evaporating water. Upon exiting the cooling tower, water vapor mixes with the surrounding air, which can lead to condensation and the formation of a visible plume. As a result, there could be aesthetic impacts from the visible plume, land-use impacts from cloud shadowing and drift deposition of dissolved salts and chemicals in the cooling water, as well as meteorological impacts from fogging and icing.

Duke used the Seasonal and Annual Cooling Tower Impacts (SACTI) computer code to estimate impacts associated with operating the CWS cooling towers. A set of two CWS cooling towers were simulated in SACTI using a height of 85 ft above site grade (Duke 2012g). Five years of surface meteorological data (2001 through 2005) collected at the Charlotte, North Carolina, first-order National Weather Service (NWS) station and mixing height values for the same period obtained from Greensboro, North Carolina—the closest NWS upper-air station—were used as input to the SACTI model. The climatology for these meteorological stations is presented in Section 2.9; these stations are reasonably representative of the Lee Nuclear Station site. Additional SACTI runs were performed using surface meteorological data from the Lee Nuclear Station site and the Greenville-Spartanburg, South Carolina, NWS station along with upper-air data from Greensboro (Duke 2011j).

Results from the SACTI analysis using the Charlotte NWS surface meteorological data, as reported by Duke (Duke 2012g), indicate that on average the longest plume lengths would occur during the winter, and the shortest plume lengths would occur during the summer. In the winter, 20 percent of plumes are 3.7 mi or longer, while in the summer 20 percent of plumes are only 0.4 mi or longer. There appears to be little seasonal difference in the longest 1 percent of the plumes that are estimated to be 6.2 mi or longer in winter and 6.1 mi or longer in summer. Ground-level fogging is likely to be infrequent and no icing events were predicted during the study period. Deposition of salts from cooling-tower drift would occur in all directions from the towers. The maximum estimated solids deposition rate for each tower is 0.0103 kg/ha/mo and occurs 200 m north of the towers (Duke 2013a). The additional SACTI runs using surface meteorological data from the Lee Nuclear Station site and the Greenville-Spartanburg NWS station yield comparable impacts in terms of magnitude relative to threshold acceptance levels (Duke 2011j); however, the actual location (direction and distance) of the maximum salt deposition varied with the meteorological data set.

The impacts described above apply to a single set of two CWS cooling towers. Two sets of CWS cooling towers (i.e., a total of four) have been proposed. The CWS cooling tower sets are separated by approximately 2000 ft, which is much greater than the 650-ft distance from the towers where the maximum salt deposition is expected to occur (Duke 2009c). Moreover, given the location and orientation of the proposed cooling towers and the predicted radius of the cooling-tower plume, it is unlikely that plumes would interact appreciably for any extended period of time. Heat transferred from the SWS cooling towers would be an order-of-magnitude less than the heat transferred by the CWS cooling towers (Duke 2009c); therefore, the plume associated with the SWS would be smaller than the plume associated with the CWS. Therefore, the review team concludes that there would be no significant meteorological impacts from the cooling towers.

Diesel generators will operate at the Lee Nuclear Station for limited periods. Interaction between pollutants emitted from these sources and the cooling-tower plumes would be intermittent and would not have a significant effect on air quality. Based on these considerations, the review team concludes that impacts on air quality from cooling-tower plume interactions with nearby emission sources would be minimal and would not require mitigation.

5.7.2 Air-Quality Impacts

Air-quality impacts from the operation of the Lee Nuclear Station Units 1 and 2 would include the release of criteria pollutants and greenhouse gases (GHGs) from the intermittent use of standby generators and emissions from worker vehicles. The following subsections describe these air-quality impacts in greater detail.

5.7.2.1 Criteria Pollutants

Air-quality impacts from operation of the proposed Lee Nuclear Station Units 1 and 2 would include intermittent releases from four standby diesel generators, four ancillary diesel generators, and two secondary diesel-driven fire pumps. In addition, the technical support center would use one diesel generator (Duke 2009c). Estimated air emissions from these sources are listed in Table 5-4. Diesel fuel oil storage tanks would be a small source of hydrocarbon emissions, with total emissions of approximately 16 lb/yr (Duke 2009c). Duke will need to obtain an operating permit through the SCDHEC, which regulates air pollution and control through Regulation 61-62 (SC Code Ann R. 61-62). The standby generators and pumps will likely be classified as minor sources due to limited operational use (Duke 2009c).

Table 5-4. Annual Emissions from Diesel Generators and Pumps for Proposed Lee Nuclear Station Units 1 and 2

Source	PM[a] (lb/yr)	SO_x[b] (lb/yr)	CO[c] (lb/yr)	VOC[d] (lb/yr)	NO_x[e] (lb/yr)
Four standby generators[f]	2168	2029	6645	2518	30,848
Four ancillary diesel generators[f]	33	31	101	38	467
Two diesel pumps	136	127	415	157	1928
Technical support center diesel generator	111	104	340	129	1578

Source: Duke 2009c
(a) PM = particulate matter
(b) SO_x = oxides of sulfur
(c) CO = carbon monoxide
(d) VOC = volatile organic compounds
(e) NO_x = oxides of nitrogen
(f) Assumes 4 hours of operation per month for each generator and use of No. 2 diesel fuel.

Air-quality impacts would also result from vehicular emissions associated with plant operations. Duke expects to employ 957 workers, spread over five shifts, during normal operation of the proposed Lee Nuclear Station Units 1 and 2. The increased traffic would be comparatively small along the major highways of the region, but obvious on the roads leading directly to the Lee Nuclear Station site, such as McKowns Mountain Road. During shift changes, increased traffic could lead to temporary congestion and idling traffic. However, the overall traffic is expected to still be within the design and capacity limits of these roads (Duke 2009c). Duke has stated that traffic mitigation measures would be considered, which also would act to reduce the impact of increased traffic on air-quality. Potential mitigation measures that Duke would consider include staggering shifts and encouraging carpools (Duke 2012k).

As discussed in Section 2.9.2, Cherokee County is an attainment area for all criteria pollutants for which National Ambient Air Quality Standards have been established (40 CFR 81.341). As a result, a conformity analysis for direct and indirect emissions is not required (40 CFR Part 93). Further, the closest Class I Federal Area (i.e., Linville Gorge Wilderness Area) is more than 50 mi from the Lee Nuclear Station site and it would, therefore, not likely be affected by limited (minor source) emissions from the site. Class I areas are considered of special national or regional natural, scenic, recreational, or historic value and are afforded additional air-quality protection.

5.7.2.2 Greenhouse Gases

The operation of a nuclear power plant involves the emission of some GHGs, primarily carbon dioxide (CO_2). The review team has estimated that the total carbon footprint for actual plant operations of proposed Lee Nuclear Station Units 1 and 2 for 40 years would be on the order of 650,000 metric tons (MT) (the sum of about 190,000 MT per unit from plant operation and about

130,000 MT per unit from operations workforce transportation) of CO_2 equivalent (an emission rate of about 16,000 MT annually, averaged over the period of operation), compared to a total U.S. annual CO_2 emissions rate of 5,500,000,000 MT (EPA 2011c). These estimates are based on carbon footprint estimates in Appendix J and emissions data contained in the ER (Duke 2009c). Based on its assessment of the relatively small plant operations carbon footprint compared to the U.S. annual CO_2 emissions, the review team concludes that the atmospheric impacts of GHGs from plant operations would not be noticeable, and additional mitigation would not be warranted.

The EPA promulgated the Prevention of Significant Deterioration (PSD) requirements and Title V GHG Tailoring Rule on June 3, 2010 (75 FR 31514). This rule states that, among other items, new and existing sources not already subject to a Title V permit, or that have the potential to emit at least 100,000 tons/yr (T/yr) (or 75,000 T/yr for modifications at existing facilities) CO_2 equivalent, will become subject to the PSD and Title V requirements effective July 1, 2011. The rule also states that sources with emissions below 50,000 T/yr CO_2 equivalent will not be subject to PSD or Title V permitting before April 30, 2016. As noted above, the annual emission rate from operations, including workforce transportation, is 16,000 MT/yr (17,600 T/yr) and is, therefore, well below the 50,000 T/yr threshold.

5.7.3 Transmission-Line Impacts

Air-quality impacts from existing transmission lines are addressed in the GEIS (NRC 2013a). Small amounts of ozone and even smaller amounts of oxides of nitrogen are produced by transmission lines. The production of these gases were found to be insignificant for 745-kV transmission lines (the largest lines in operation) and for a prototype 1200-kV transmission line. In addition, potential mitigation measures, such as burying transmission lines, would be very costly and would not be warranted.

Four new transmission lines (two 230-kV and two 525-kV lines) would be constructed to accommodate the new power generating capacity (Duke 2009c). This size is well within the range of transmission lines analyzed in the GEIS; therefore, the review team concludes that air-quality impacts from transmission lines would be minimal, and additional mitigation would not be warranted.

5.7.4 Summary of Meteorological and Air-Quality Impacts

The review team evaluated the meteorological impacts from fogging and icing as a result of cooling-tower operations at the proposed Lee Nuclear Station Units 1 and 2. The review team also considered the timing and magnitude of criteria air pollutant emissions related to operations, the existing air quality at the Lee Nuclear Station site and the distance to the closest Class I Federal Area, and Duke's commitment to manage and mitigate emissions in accordance with applicable regulations. The review team evaluated potential impacts of GHG emissions from operating the proposed Lee Nuclear Station Units 1 and 2. The review team also evaluated potential impacts of cooling-system emissions and transmission lines. In each case, the review team determined that the impacts would be minimal. On this basis, the review team concludes that the impacts of operation of the proposed Lee Nuclear Station Units 1 and 2 on meteorology, air quality from criteria pollutant emissions, GHG emissions, cooling-system emissions, and transmission lines would be SMALL, and no further mitigation is warranted.

5.8 Nonradiological Health Impacts

This section addresses the nonradiological health impacts of operating two proposed nuclear reactors at the Lee Nuclear Station site. Nonradiological health impacts to the public from operation of the cooling system, noise generated by unit operations, EMFs, and transporting operations and outage workers are discussed. Nonradiological health impacts from the same sources also are evaluated for workers at the proposed Lee Nuclear Station. Health impacts from radiological sources during operations are discussed in Section 5.9.

5.8.1 Etiological (Disease-Causing) Agents

Operation of proposed Lee Nuclear Station Units 1 and 2 would result in a thermal discharge through a multiport diffuser to the Broad River/Ninety-Nine Islands Reservoir, just upstream of the Ninety-Nine Islands Dam (Duke 2009c). Such discharges of heated water have the potential to increase the growth of thermophilic microorganisms (microorganisms that favor warmer water), including etiological agents, both in the CWS and the Broad River. Thermophilic microorganisms include enteric pathogens such as *Salmonella* spp., *Pseudomonas aeruginosa*, thermophilic fungi, bacteria such as *Legionella* spp., and free-living amoeba, such as *Naegleria fowleri* (N. fowleri) and *Acanthamoeba* spp. These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels. Section 2.10.1.3 discusses the incidence of waterborne diseases in South Carolina and specifically Cherokee County. Incidence of diseases such as Legionellosis, Salmonellosis, or Shigellosis is possible through exposure to water vapor generated by the operation of cooling towers for the proposed Lee Nuclear Station Units 1 and 2. Although workers would have the potential to be exposed to the water vapor, members of the public would not be allowed close enough to the Lee Nuclear Station site to be exposed to water vapor from operation of the proposed Units 1 and 2.

As discussed in Section 2.10, the main recreational activities associated with the Broad River and the Ninety-Nine Islands Reservoir are fishing, boating, and occasional swimming. Participating in these recreational activities in the vicinity of the Lee Nuclear Station discharge could expose members of the public to etiological agents. However, epidemiological reports from the State of South Carolina indicate a very low risk of outbreaks from disease-causing microorganisms associated with recreational water (CDC 2008). In the South Carolina Annual Report on Reportable Conditions for the years 2007 and 2008, the SCDHEC reported 16 and

12 cases of Legionellosis, 6 and 5 cases of Salmonellosis, and 1 case of Shigellosis in Cherokee County (SCDHEC 2010b). The number of South Carolina cases are far below national trends (SCDHEC 2010b).

Thermophilic microorganisms generally occur at water temperatures of 77 to 176°F, with optimum growth occurring between 122 and 150°F and a minimum tolerance of 68°F (Joklik and Willett 1995). *N. fowleri* is common in freshwater ponds, lakes, and reservoirs throughout the southern states. As discussed in Section 5.2.3.1, the review team determined that the temperature in the Broad River would increase 3.8°F and 3.6°F in January and August respectively, conservatively assuming maximum discharge (64 cfs) downstream of the Ninety-Nine Islands Dam. The highest monthly mean temperature in the Broad River was 86°F in August 2007, and the addition of the heated discharge to the Broad River would likely increase temperatures in some portions of the river below the Ninety-Nine Islands Dam to 90°F. While it is possible that this increase in river water temperature could cause a minor increase in the abundance of thermophilic organisms, there would no discernible impact on health.

It is recommended that nuclear power station staff working around heated effluent take precautions to protect themselves from infection. This action significantly reduces the potential for exposure. Duke has stated they would follow Occupational Safety and Health Administration (OSHA) requirements to protect workers (Duke 2009c). The general public would not be impacted because aerosolized bacteria would travel only a short distance from the cooling towers and condensers. Based on the historically low risk of diseases from etiological agents in South Carolina, the limited opportunities for public exposure, and the limited extent of thermal impacts in the Broad River, the review team concludes that the impacts on human health would be minimal, and mitigation would not be warranted.

5.8.2 Noise

In the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996), the NRC staff discusses the environmental impacts of noise at existing nuclear power plants. Common sources of noise from operations include cooling towers, transformers, and the operation of pumps, with intermittent contributions from loud speakers and auxiliary equipment (e.g., diesel generators). A common source of noise relevant to high-voltage transmission is corona discharge (Duke 2009c). These noise sources are discussed in this section.

The primary sources of background noise at the Lee Nuclear Station site are discussed in Section 2.10.2. The landscape in the vicinity of the proposed site is rural and forested, with predominately deciduous forests (approximately 45 percent) (Duke 2009c). Noise sources at the proposed site would include pumps, cooling towers, transformers, switchyard equipment, and loudspeakers (Duke 2009c). Many of these noise sources are confined indoors or are infrequent. The main sources of noise are the four mechanical draft cooling towers.

Mechanical draft cooling towers generate noise at level of approximately 85 dBA. Calculations that include the effect of the previously proposed six cooling towers have been made for a number of locations, including approximately 1692 ft away from the cooling towers at the north fence line, 0.99 mi away for the nearest residence, and 4577 ft away for the nearest church. The overall projected combined ambient and cooling-tower noise levels range from approximately 48 to 64 dBA (Duke 2011b). The expected noise from the four cooling towers currently proposed by Duke (Duke 2011j) would be expected to fall within or below this range. Noise from corona discharge along proposed transmission lines is expected to be less than 10 dBA (Duke 2009c). According to the GEIS (NRC 1996), noise levels below 60 to 65 dBA are considered to be of small significance. These estimates are conservative because all four towers are assumed to be the same distance from the receptor, and no shielding of the sound by adjacent structures or topography has been assumed. More recently, the impacts of noise were considered in the GEIS*, Supplement 1* (NRC 2002). The criterion for assessing the level of significance was not expressed in terms of sound levels but rather the effect of noise on human activities and threatened and endangered species. The criterion in GEIS, Sup. 1 (NRC 2002) is stated as follows:

> The noise impacts ... are considered detectable if sound levels are sufficiently high to disrupt normal human activities on a regular basis. The noise impacts ... are considered destabilizing if sound levels are sufficiently high that the affected area is essentially unsuitable for normal human activities, or if the behavior or breeding of a threatened and endangered species is affected.

Given the postulated noise levels for mechanical draft cooling towers and diesel generators, the site characteristics and noise attenuation, and the criteria described in the GEIS, Sup. 1 (NRC 2002), the review team concludes that potential noise impacts would be minor and mitigation would not be warranted.

5.8.3 Acute Effects of Electromagnetic Fields

Electric shock resulting from either direct access to energized conductors or induced charges in metallic structures is an example of an acute effect from EMFs associated with transmission lines (NRC 1999a). Two 230-kV and two 525-kV transmission lines would service the proposed Lee Nuclear Station Units 1 and 2 (Duke 2009c). The National Electric Safety Code (NESC) (IEEE 2011) describes minimum vertical clearances to the ground for transmission power lines exceeding 98 kV such that the current induced in an object below the transmission lines is less than 5 mA. For example, a 500-kV transmission line minimally requires 45 ft of clearance. Duke commits to design any new transmission lines in compliance with the 5-mA standard prescribed by NESC. With Duke’s commitment to design new transmission lines in compliance with NESC criteria, the review team concludes that the impact to the public from acute effects of EMF would be SMALL, and additional mitigation would not be warranted.

5.8.4 Chronic Effects of Electromagnetic Fields

Research on the potential for chronic effects from 60-Hz EMFs from energized transmission lines was reviewed and addressed elsewhere by the NRC in NUREG-1437 (NRC 1996). At that time, research results were not conclusive. The National Institute of Environmental Health Sciences (NIEHS) directs related research through the U.S. Department of Energy. An NIEHS report (NIEHS 1999) contains the following conclusion:

> The NIEHS concludes that ELF-EMF (extremely low frequency-electromagnetic field) exposure cannot be recognized as entirely safe because of weak scientific evidence that exposure may pose a leukemia hazard. In our opinion, this finding is insufficient to warrant aggressive regulatory concern. However, because virtually everyone in the United States uses electricity and therefore is routinely exposed to ELF-EMF, passive regulatory action is warranted such as a continued emphasis on educating both the public and the regulated community on means aimed at reducing exposures. The NIEHS does not believe that other cancers or non-cancer health outcomes provide sufficient evidence of a risk to currently warrant concern.

This statement is not sufficient to cause the review team to consider the potential impact as significant to the public. Furthermore, Duke states that it will attempt to avoid occupied buildings when selecting transmission-line routes (Duke 2009c).

5.8.5 Occupational Health

As discussed in Section 2.10, occupational health risks for workers at the Lee Nuclear Station site are expected to be dominated by occupational injuries (e.g., falls, electric shock, asphyxiation, etc.) to workers engaged in activities such as maintenance, testing, and plant modifications. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. The 2009 annual incidence rates (the number of injuries and illnesses per 100 full-time workers) for South Carolina and the United States for electric power generation, transmission and distribution workers are 1.5 and 3.3, respectively (BLS 2011a, b). Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards (29 CFR Part 1910), practices, and procedures. Appropriate State and local statutes must also be considered when assessing the occupational hazards and health risks of nuclear reactor operation. For the purposes of the evaluation of nonradiological health impacts, the review team assumes adherence to NRC, OSHA, and State safety standards, practices, and procedures during nuclear power station operations.

Additional occupational health impacts may result from exposure to hazards such as noise, toxic or oxygen-replacing gases, thermophilic microorganisms in the condenser bays, and caustic agents. The *Duke Energy 2010/2011 Sustainability Report* (Duke Energy 2011a) reports that it maintains a health and safety program to protect workers from industrial safety risks. The number of recordable incidents per 100 workers (based on OSHA criteria) was 0.90 in 2010 (for comparison, the lowest incidence for the electric utility industry in 2009 was 0.69) (Duke Energy 2011a). The review team concludes that health impacts to workers from nonradiological emissions, noise, EMFs, and other occupational risks would be monitored and controlled in accordance with applicable OSHA regulations and would be minimal. No further mitigation would be warranted.

5.8.6 Impacts of Transporting Operations Personnel to the Lee Nuclear Station Site

The general approach used to calculate nonradiological impacts of fuel and waste shipments is the same as that used to calculate the impacts of transporting operations and outage personnel to and from the Lee Nuclear Station site. However, preliminary estimates are the only data available to estimate these impacts. The assumptions made to fill in reasonable estimates of the data needed to calculate nonradiological impacts are discussed below.

- The number of workers needed for operating Units 1 and 2 was provided in Duke's ER (2009c) as 1000 workers. An additional 800 temporary workers are estimated to be needed for refueling outages every 18 months (Duke 2009c). With two units operating it is expected there will be an outage every year.
- The average commute distance for operations and outage workers was assumed to be 80 km (50 mi) one way.
- To develop representative commuter traffic impacts, the U.S. Department of Transportation (DOT) provided the South Carolina-specific fatality rate for all traffic for the years 2003 to 2007 (DOT 2009). The average fatality rate for the 2003 to 2007 period in South Carolina was used as the basis for estimating South Carolina-specific injury and accident rates. Adjustment factors were developed using national-level traffic accident statistics in the U.S. Department of Transportation publication *National Transportation Statistics 2007* (DOT 2007). The adjustment factors are the ratio of the national injury rate to the national fatality rate and the ratio of the national accident rate to the national fatality rate. These adjustment factors were multiplied by the South Carolina-specific fatality rate to approximate the injury and accident rates for commuters in South Carolina.

The estimated effects of transporting operations and outage workers to and from the Lee Nuclear Station site are shown in Table 5-5. The annual traffic fatalities during operations, including both operations and outage personnel, represent about a 1.3 percent increase above the 45 traffic fatalities that occurred in Cherokee and York Counties in 2007 (DOT 2009). This represents a small increase relative to the current traffic fatality risk in the area surrounding the Lee Nuclear Station site. The review team concludes that the impacts of transporting construction materials and personnel to the Lee Nuclear Station site would be minimal, and mitigation would not be warranted.

Table 5-5. Nonradiological Impacts of Transporting Workers to/from the Lee Nuclear Station for Two Reactors

	Accidents per Year Per Unit	Injuries per Year per Unit	Fatalities per Year Per Unit
Permanent workers	150	68	1.1
Outage workers	15	6.6	0.1

5.8.7 Summary of Nonradiological Health Impacts

The review team evaluated health impacts to the public and the workers from the proposed cooling systems, noise generated by plant operations, acute and chronic impacts of EMFs, and transporting operations and outage workers to and from the Lee Nuclear Station site. Health risks to workers are expected to be dominated by occupational injuries at rates below the average U.S. industrial rate. Health effects to the public and workers from thermophilic microorganisms, noise generated by unit operations, and acute impacts of EMFs would be minimal. The review team reviewed available scientific literature on chronic effects of EMF on human health and found that the scientific evidence regarding the chronic effects of ELF-EMF on human health does not conclusively link ELF-EMF to adverse health impacts. Based on the information provided by Duke and the NRC's own independent evaluation, the review team concludes that the potential for nonradiological health impacts resulting from the operation of the two proposed nuclear units would be SMALL, and mitigation would not be warranted. The review team has not come to a conclusion on the chronic impacts of EMFs.

5.9 Radiological Health Impacts of Normal Operations

This section addresses the radiological impacts of normal operations of the proposed Lee Nuclear Station Units 1 and 2, including the estimated radiation dose to a member of the public and to the biota inhabiting the area around the Lee Nuclear Station site. Estimated doses to workers at the proposed units are also discussed. Radiological impacts were determined using the Westinghouse Advanced Passive (AP1000) reactor design with expected direct radiation and liquid and gaseous radiological effluent rates in the evaluation (see discussion in Section 3.4.3).

Revision 19 of the AP1000 design (Westinghouse 2011) is a certified design as set forth in 10 CFR Part 52, Appendix D. Duke's application incorporates Revision 19 of the AP1000 Design Control Document (DCD); and, the COL application and evaluation of radiological impacts of normal operations presented here are based on Revision 19 of the AP1000 DCD (Westinghouse 2011).

5.9.1 Exposure Pathways

The public and biota would receive radiation dose from a nuclear power station via the liquid effluent, gaseous effluent, and direct radiation pathways. Duke estimated the potential exposures to the public and biota by evaluating exposure pathways typical of those surrounding the proposed Units 1 and 2 at the Lee Nuclear Station site. They considered pathways that could cause the highest calculated radiological dose based on the use of the environment by the residents located around the site (Duke 2013a). For example, factors such as the location of homes in the area and consumption of meat and vegetables grown in the area were considered.

For the liquid effluent release pathway, Duke considered the following exposure pathways in evaluating the dose to the maximally exposed individual (MEI): ingestion of aquatic food (i.e., sport fishing); ingestion of drinking water; and direct radiation exposure from shoreline activities, swimming, and boating (see Figure 5-1). The analysis for population dose considered the following exposure pathways: ingestion of aquatic food, ingestion of drinking water, and direct radiation exposure from shoreline, swimming, and boating activities. Liquid effluents were assumed to be released via the planned discharge structure into the forebay behind Ninety-Nine Islands Dam, which is located on the Broad River).

As discussed in the DCD, the design of proposed Lee Nuclear Station Units 1 and 2 includes a number of features to prevent and mitigate leakage from system components such as pipes and tanks that may contain radioactive material (Westinghouse 2011). In addition, Duke committed to use the guidance of Nuclear Energy Institute (NEI) 08-08 (NEI 2008), *Generic FSAR Template Guidance for Life-Cycle Minimization of Contamination*, to the extent practicable in the development of operating programs and procedures (Duke 2013a). However, the potential still exists for leaks of radioactive material, such as tritium, into the ground. Based on the discussion above, the NRC staff expects that the impacts from such potential leakage for proposed Lee Nuclear Station Units 1 and 2 would be minimal.

For the gaseous effluent release pathway, Duke (2013a) considered the following exposure pathways in evaluating the dose to the MEI: immersion in the radioactive plume, direct radiation exposure from deposited radioactivity, inhalation, ingestion of garden fruit and vegetables, ingestion of goat and cow milk, and ingestion of meat animals.

For population doses from the gaseous effluents, Duke (2009c) used the same exposure pathways as those used for the individual dose assessment (Figure 5-1). All agricultural products grown within 50 mi of proposed Lee Nuclear Station Units 1 and 2 were assumed to be consumed by the population within 50 mi of the Lee Nuclear Station site.

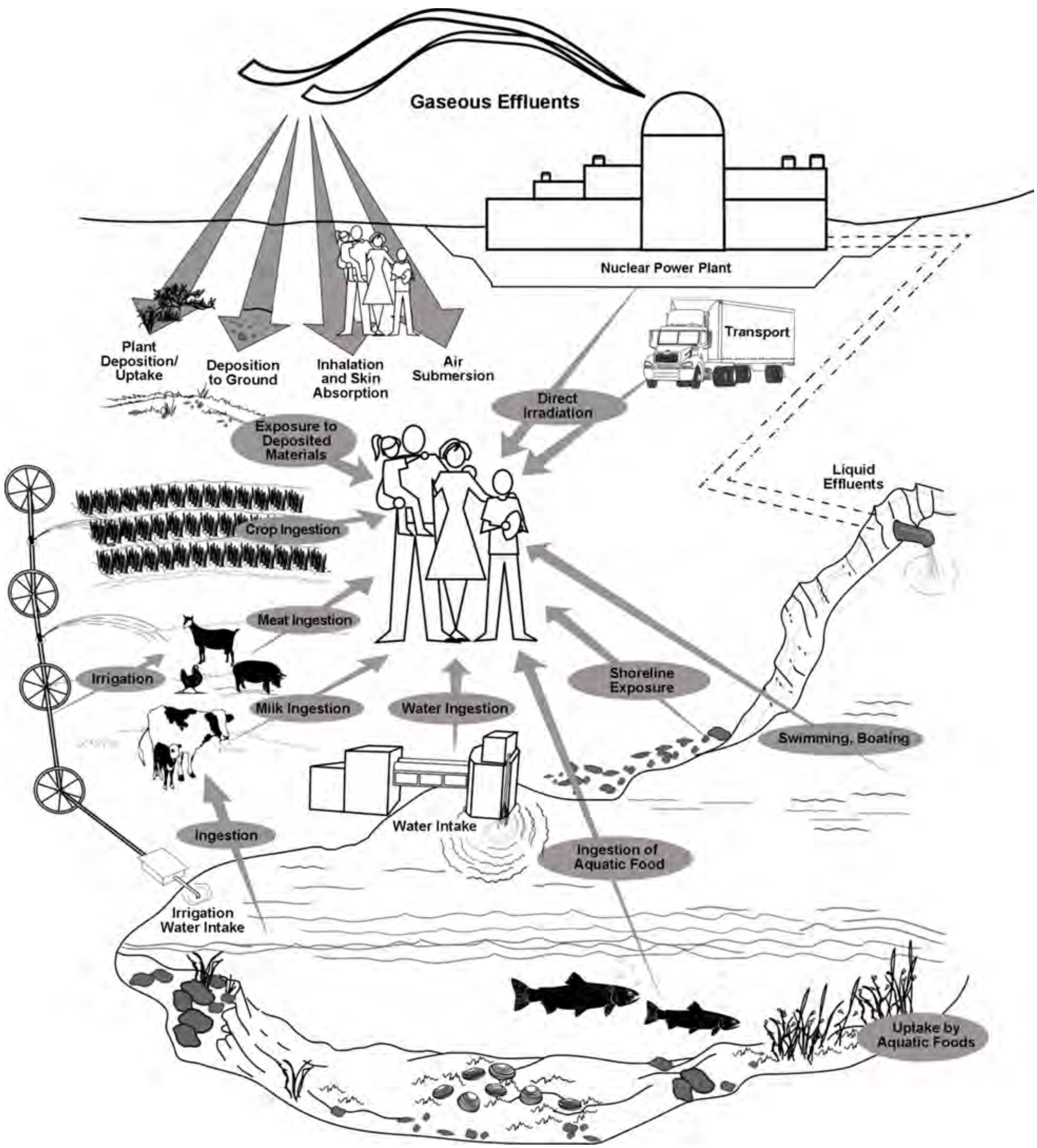

Figure 5-1. Exposure Pathways to Man (adapted from Soldat et al. 1974)

Duke (2009c) stated that direct radiation from the proposed Lee Nuclear Station during normal operation would be a potential source of radiation exposure to the public from the Lee Nuclear Station site. However, Duke assumed that contained sources of radiation at the proposed Lee Nuclear Station Units 1 and 2 would be shielded and would not contribute to the external dose of the MEI or the population. The assumption of negligible contribution from direct radiation beyond the site boundary is supported by the AP1000 DCD (Westinghouse 2011). The containment and other plant buildings would be shielded and direct radiation from them would be negligible. The AP1000 design also provides for the storage of refueling water inside the containment building instead of in an outside storage tank. This planned storage eliminates refueling water as a source of significant direct radiation to offsite receptors.

Source terms used to estimate exposure pathway doses were taken from Tables 11.2-7 and 11.3-3 in the AP1000 DCD (Westinghouse 2011). Duke identified no unusual exposure pathways, such as unusual plants, agricultural practices, animals, game harvests, or food processing operations (Duke 2009c, 2013a).

Exposure pathways considered in evaluating dose to the biota are shown in Figure 5-2 and include the following:

- ingestion of aquatic foods
- ingestion of water
- external exposure from water immersion or shoreline sediments
- inhalation of airborne radionuclides
- external exposure to immersion in gaseous effluent plumes
- surface exposure from deposition of iodine and particulates from gaseous effluents (NRC 1977b).

The NRC staff reviewed the exposure pathways for the public and biota identified by Duke (2009c) and found them to be appropriate, based on a documentation review, a tour of the environs, and interviews with Duke staff and contractors during the site audit in April and May 2008.

5.9.2 Radiation Doses to Members of the Public

Duke calculated the dose to the MEI and the population living within a 50-mi radius of the site from both the liquid and gaseous effluent release pathways (Duke 2009c, 2013a). As discussed in Section 5.9.1, direct radiation exposure to the MEI from sources of radiation at the proposed Lee Nuclear Station Units 1 and 2 would be negligible.

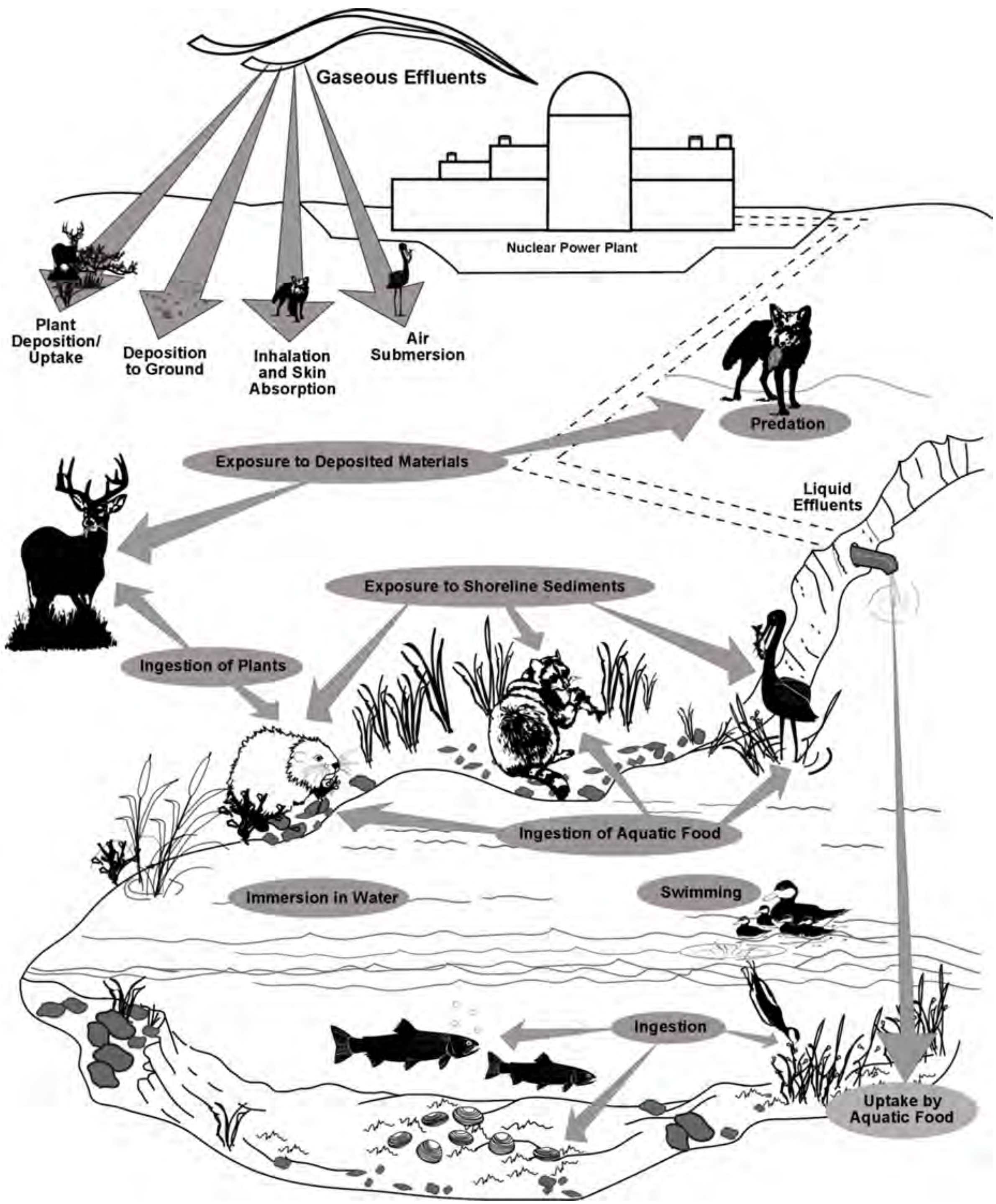

Figure 5-2. Exposure Pathways to Biota Other than Man (adapted from Soldat et al. 1974)

5.9.2.1 Liquid Effluent Pathway

Liquid pathway doses were calculated using the LADTAP II computer program (Strenge et al. 1986). The following activities were considered in the dose calculations: (1) consumption of drinking water contaminated by liquid effluents, (2) consumption of fish from water sources contaminated by liquid effluents, and (3) direct radiation from waterbodies contaminated by liquid effluents during swimming, boating, and recreation along the shoreline. The liquid effluent releases used in the estimates of dose are found in Table 11.2-7 of the AP1000 DCD (Westinghouse 2011) and listed in Table G-1 of Appendix G of this EIS. Other parameters used as inputs to the LADTAP II program include effluent discharge rate, 50-mi populations (total and those using drinking water); transit times to receptors; shoreline, swimming, and boating usage; and liquid pathway consumption and usage factors (i.e., sport fish consumption), and are found in Tables 5.4-1 and 5.4-2 of the ER (Duke 2009c) and listed in Table G-1 of Appendix G of this EIS. The nearest drinking water withdrawal point downstream of the Lee Nuclear Station site is the City of Union, South Carolina, about 21 mi downstream. Duke found no record of irrigation from the Broad River downstream of the Lee Nuclear Station site. Where not otherwise specified, default parameters were used with LADTAP II.

Duke calculated liquid pathway doses to the MEI as shown in Table 5-6. (Duke 2009c, 2013a). The MEI was calculated to be an adult with the majority of the dose from drinking water. The maximally exposed organ was calculated to be the liver of a child.

Table 5-6. Annual Doses to the Maximally Exposed Individual for Liquid Effluent Releases from a New Unit

Pathway	Age Group	Total Body (mrem/yr)	Maximum Organ (Liver) (mrem/yr)	Thyroid (mrem/yr)
Drinking water	Adult	0.0202	0.0204	0.0279
	Teen	0.0141	0.0146	0.0209
	Child	0.0267	0.0282	0.0437
	Infant	0.0261	0.0282	0.0532
Fish and other organisms	Adult	0.0406	0.0550	0.0042
	Teen	0.0232	0.0564	0.0038
	Child	0.0092	0.0492	0.0039
Direct radiation	Adult	0.00004	0.00004	0.00004
	Teen	0.0002	0.0002	0.0002
	Child	0.00005	0.00005	0.00005
Total	Adult	0.0609	0.0755	0.0321
	Teen	0.0375	0.0713	0.0250
	Child	0.0360	0.0775	0.0477
	Infant	0.0261	0.0282	0.0532

Source: Duke 2013a

The NRC staff recognizes the LADTAP II computer program as an appropriate method for calculating dose to the MEI for liquid effluent releases. All input parameters used in Duke's calculations were judged by the NRC staff to be appropriate.

The NRC staff performed an independent evaluation of liquid pathway doses. For its analysis, the NRC staff used a value for the mean annual flow rate of the Broad River of 1858 cfs for the water years 2000 to 2010 as measured at the USGS gage at Ninety-Nine Islands Dam (USGS 2010a); Duke used a longer-term average of 2538 cfs in their estimates (Duke 2009c, 2013a). When this difference is accounted for, the NRC staff obtained similar results to those estimated by Duke. The results of the NRC staff's independent review are found in Appendix G.

5.9.2.2 Gaseous Effluent Pathway

Duke calculated gaseous pathway doses to the MEI using the GASPAR II computer program (Strenge et al. 1987) at the nearest residences and the exclusion area boundary (EAB). The GASPAR II computer program was also used to calculate annual population doses. The following activities were considered in the dose calculations: (1) direct radiation from immersion in the gaseous effluent cloud and from particulates deposited on the ground, (2) inhalation of gases and particulates, (3) ingestion of meat from animals eating contaminated grass, (4) ingestion of milk from animals eating contaminated grass, and (5) ingestion of garden vegetables contaminated by gases and particulates. The gaseous effluent releases used in the estimate of dose to the MEI and population are found in Table 11.3-3 of the AP1000 DCD (Westinghouse 2011) and Table G-3 of Appendix G. Other parameters used as inputs to the GASPAR II program, including population data, atmospheric dispersion factors, ground deposition factors, receptor locations, and consumption factors, are found in Tables 2.3-287 through 2.3-292, and 11.3-201 of the Final Safety Analysis Report (FSAR) (Duke 2013a). Gaseous pathway doses to the MEI calculated by Duke are presented in Table 5-7. Duke added the highest dose for each pathway independent of the location to estimate the MEI dose.

The NRC staff recognizes the GASPAR II computer program as an appropriate tool for calculating dose to the MEI and population from gaseous effluent releases. The NRC staff reviewed the input parameters and values used by Duke (Duke 2013a) for appropriateness, including references made to the AP1000 DCD (Westinghouse 2011). The NRC staff concluded that the assumed input parameters and values used by Duke were appropriate. The NRC staff performed an independent evaluation of gaseous pathway doses and obtained similar results for the MEI (see Appendix G for details).

Table 5-7. Doses to the MEI from Gaseous Effluent Pathway for a New Unit[(a)]

Pathway	Age Group	Total Body Dose (mrem/yr)	Max Organ (mrem/yr)	Skin Dose (mrem/yr)	Thyroid Dose (mrem/yr)
Plume (0.27 mi NW)[(b)]	All	0.732	0.804 (lung)	4.900	0.732
Ground (0.27 mi NW)[(b)]	All	0.253	0.253 (thyroid)	0.298	0.253
Inhalation (0.27 mi NW)[(b)]	Adult	0.123	1.070 (thyroid)	0.120	1.070
	Teen	0.124	1.330 (thyroid)	0.121	1.330
	Child	0.110	1.540 (thyroid)	0.107	1.540
	Infant	0.064	1.380 (thyroid)	0.061	1.380
Vegetables (1.00 mi SSE)[(b)]	Adult	0.138	0.908 (thyroid)	0.127	0.908
	Teen	0.207	1.230 (thyroid)	0.196	1.230
	Child	0.459	2.420 (thyroid)	0.443	2.420
Meat (1.65 mi SE)[(c)]	Adult	0.040	0.173 (bone)	0.039	0.066
	Teen	0.032	0.146 (bone)	0.032	0.051
	Child	0.058	0.274 (bone)	0.058	0.087
Cow milk (1.65 mi SE)	Adult	0.054	0.813 (thyroid)	0.048	0.813
	Teen	0.089	1.290 (thyroid)	0.083	1.290
	Child	0.199	2.600 (thyroid)	0.191	2.600
	Infant	0.399	6.230 (thyroid)	0.388	6.230
Goat milk (1.05 mi SSW)	Adult	0.057	0.996 (thyroid)	0.043	0.996
	Teen	0.086	1.580 (thyroid)	0.071	1.580
	Child	0.171	3.150 (thyroid)	0.156	3.150
	Infant	0.326	7.580 (thyroid)	0.307	7.580

Source: Duke 2013a, d, g

(a) Ground-level releases were assumed. Doses are based on two year's meteorological data.

(b) In response to an NRC staff RAI, Duke re-evaluated its air dispersion modeling and revised their calculations (Duke 2013g). At the time of publication of this final EIS, the NRC staff review of the applicant's RAI response to assure that the applicant meets all applicable regulatory requirements is ongoing. NRC's evaluation of Duke's response will be addressed in the NRC's Final Safety Evaluation Report (FSER) and any changes to the COL application that are deemed necessary will be incorporated into the applicant's FSAR.

(c) No infant doses were calculated for the vegetable and meat pathway because the doses that infants receive from this diet would be bounded by the dose calculated for the child

5.9.3 Impacts on Members of the Public

This section describes Duke's evaluation of the estimated impacts from radiological releases and direct radiation from proposed Lee Nuclear Station Units 1 and 2. The evaluation addresses dose from operations to the MEI located at the Lee Nuclear Station site and the population dose (collective dose to the population within 50 mi) around the site.

5.9.3.1 Maximally Exposed Individual

Duke (2009c) stated that total body and organ dose estimates to the MEI from liquid and gaseous effluents for the two nuclear units would be within the dose design objectives of

10 CFR Part 50, Appendix I. Doses to total body and maximum organ at the Broad River from liquid effluents were well within the respective 3 and 10 mrem/yr Appendix I dose design objectives. Doses at the site boundary and the EAB from gaseous effluents would be well within the Appendix I dose design objectives of 10 mrad/yr air dose from gamma radiation, 20 mrad/yr air dose from beta radiation, 5 mrem/yr to the total body, and 15 mrem/yr to the skin. In addition, dose to the thyroid from gaseous effluents would be within the 15 mrem/yr Appendix I dose design objective. A comparison of dose estimates for each of the proposed units to the Appendix I dose design objectives is found in Table 5-8. The NRC completed an independent evaluation of compliance with Appendix I dose design objectives and found similar results, as shown in Appendix G. Gaseous and liquid effluents from the Lee Nuclear Station would be below the Appendix I dose design objectives (Duke 2009c, 2013a).

Table 5-8. Comparison of MEI Dose Estimates for a Single New Nuclear Unit from Liquid and Gaseous Effluents to 10 CFR Part 50, Appendix I, Dose Design Objectives

Pathway/Type of Dose	Duke Dose Estimates	Appendix I Design Objectives
Liquid effluents		
Total body dose	0.0609 mrem (adult)	3 mrem/yr
Maximum organ dose	0.0775 mrem (child liver)	10 mrem
Gaseous effluents (noble gases only)[(a)]		
Gamma air dose	1.25 mrad	10 mrad
Beta air dose	7.32 mrad	20 mrad
Total body dose	0.732 mrem	5 mrem/yr
Skin dose	4.90 mrem	15 mrem
Gaseous effluents (radioiodines and particulates)[(b,c)]		
Organ dose	9.21 mrem (infant thyroid)	15 mrem

Source: Duke 2009c, 2013a, g
(a) Northwest site boundary; ground-level releases assumed.
(b) Includes tritium, carbon-14, food chain, and inhalation doses.
(c) Includes infant drinking home-produced goat milk.

Duke compared the combined dose estimates from direct radiation and gaseous and liquid effluents from the proposed Lee Nuclear Station Units 1 and 2 with the 40 CFR Part 190 standards (Duke 2013a). Duke (2013a) states that dose estimates from combined liquid and gaseous effluents to the MEI at the nearest residence from the Lee Nuclear Station are well within the regulatory standards of 40 CFR Part 190. As stated earlier, exposure at the site boundary from direct radiation sources at the new units would be negligible. Table 5-9 compares Duke’s calculated doses from the two proposed units to the dose standards from 40 CFR Part 190; i.e., 25 mrem/yr to the total body, 75 mrem/yr to the thyroid, and 25 mrem/yr to any other organ. The NRC staff completed an independent evaluation of compliance with 40 CFR Part 190 standards and found similar results, as shown in Appendix G.

Table 5-9. Comparison of MEI Dose Estimates from Liquid and Gaseous Effluents to 40 CFR Part 190 Standards

Dose	Estimate (mrem)[(a)]	Standards (mrem)
Whole body dose	3.74	25
Thyroid dose	20.0	75
Dose to another organ	9.05 (child bone)	25

Source: Duke 2013g; 40 CFR Part 190
(a) Sum of dose from liquid and gaseous effluent releases for two proposed units.

5.9.3.2 Population Dose

Duke estimated that the collective total body dose within a 50-mi radius of the proposed Lee Nuclear Station Units 1 and 2 for the gaseous pathways would be 5.00 person-rem/yr for each unit (Duke 2013a). Duke estimated that the collective total body dose within a 50-mi radius of the proposed Lee Nuclear Station Units 1 and 2 for the aquatic pathways would be 0.296 person-rem/yr for each unit (Duke 2013a). The combined total for both types of effluent and both units would be 10.6 person-rem/yr. The estimated collective dose to the same population from natural background radiation is estimated as 1,305,000 person-rem/yr. The dose from natural background radiation was calculated by multiplying the 50-mi radius population estimate (4,195,000) for the year 2056 by the annual background dose rate (311 mrem/yr) (NCRP 2009).

Collective dose was estimated by summing the doses from the gaseous (calculated using the GASPAR II computer code) and liquid effluent (calculated using the LADTAP II computer code) pathways. The NRC staff performed an independent evaluation of population doses and obtained similar results (see Appendix G).

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold dose response model as a basis for estimating risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv) equal to 0.00057 effect per person-rem. The coefficient is taken from Publication 103 of the International Commission on Radiological Protection (ICRP 2007).

Both the National Council on Radiation Protection and Measurements (NCRP) and ICRP suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (in other words, less than 1/0.00057, which is less than 1754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995; ICRP 2007). As noted above, the estimated collective whole body dose to the population living within 50 mi of the Lee Nuclear Station site is 10.6 person-rem/yr, which is less than the value of 1754 person-rem/yr that ICRP and NCRP suggest would most likely result in zero excess health effects (NCRP 1995; ICRP 2007).

In addition, at the request of the U.S. Congress, the National Cancer Institute (NCI) conducted a study and published, *Cancer in Populations Living Near Nuclear Facilities*, in 1990 (Jablon et al. 1990). The NCI report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel cycle facilities, in operation in the United States in 1981 and found "… no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (Jablon et al. 1990).

5.9.3.3 Summary of Radiological Impacts to Members of the Public

The NRC staff evaluated the potential health impacts from routine gaseous and liquid radiological effluent releases from the proposed Lee Nuclear Station Units 1 and 2. Based on the information provided by Duke, and the NRC's own independent evaluation, the NRC staff concluded that there would be no observable health impacts to the public from normal operation of the units, any health impacts would be SMALL, and additional mitigation would not be warranted.

5.9.4 Occupational Doses to Workers

The collective occupational dose for a single AP1000 reactor was estimated at 63.2 person-rem/yr in the AP1000 DCD (Westinghouse 2011). The licensee of a new plant would be required to maintain individual doses to workers to within 5 rem annually as specified in 10 CFR 20.1201 and incorporate provisions to maintain doses as low as reasonably achievable (ALARA). To maintain doses to workers ALARA, Duke plans to establish comprehensive worker training, monitoring, and radiation safety programs (Duke 2013a based on the NEI 07-03A, *Generic FSAR Template Guidance for Radiation Protection Program Description* (NEI 2009a).

The NRC staff concludes that the health impacts from occupational radiation exposure at the Lee Nuclear Station site would be SMALL based on individual worker doses being maintained within 10 CFR 20.1201 limits and collective occupational doses being typical of doses found in current operating light water reactors. Additional mitigation would not be warranted because the operating plant would be required to maintain doses ALARA.

5.9.5 Impacts on Biota Other than Humans

Duke estimated doses to biota in the environs for the Lee Nuclear Station site using surrogate species. Surrogate species used in the ER are well-defined and provide an acceptable method for evaluating doses to the biota. Surrogate species analysis was performed for aquatic species (e.g., fish, invertebrates, and algae) and terrestrial species (e.g., muskrats, raccoons, herons, and ducks) (Duke 2009c). Aquatic species on the Lee Nuclear Station site are represented by the freshwater fish, invertebrates, and algae surrogates. Terrestrial species are represented by the muskrat and raccoon surrogates; birds are represented by the heron and duck surrogates. Exposure pathways considered in evaluating dose to the biota are discussed in Section 5.9.1 and shown in Figure 5-2. The NRC staff's independent evaluation considered surrogate species and found results similar to those reported by Duke (2009c) (see Appendix G).

5.9.5.1 Liquid Effluent Pathway

Duke (2009c) used the LADTAP II computer code to calculate doses to the biota from the liquid effluent pathway. In estimating the concentration of radioactive effluents in the Broad River, Duke (2009c) used a simple mixing model for the river below Ninety-Nine Islands Dam. (The NRC staff also considered radionuclide concentrations in the forebay of the Ninety-Nine Islands Dam, just before the spillway; see Appendix G.) Liquid pathway doses were higher for biota compared to humans because of considerations for bioaccumulation of radionuclides, ingestion of aquatic plants, ingestion of invertebrates, and increased time spent in the water and on the shoreline compared to humans. The liquid effluent releases used in estimating biota dose are found in the AP1000 DCD (Westinghouse 2011, Table 11.2-7). Total body dose estimates to the surrogate species from the liquid and gaseous pathways are shown in Table 5-10.

Table 5-10. Biota Doses for the Lee Nuclear Station Units 1 and 2

Biota	Liquid Effluents Dose (mrad/yr)	Gaseous Effluents Dose (mrad/yr)	Total Body Biota Dose All Pathways (mrad/yr)
Fish	0.57	-	0.57
Invertebrate	1.61	-	1.61
Algae	4.64	-	4.64
Muskrat	1.71	4.06	5.77
Raccoon	0.67	3.25	3.92
Heron	7.82	3.18	11.00
Duck	1.64	3.80	5.44

Source: Duke 2009c, Table 5.4-17, Duke 2013g

5.9.5.2 Gaseous Effluent Pathway

Gaseous effluents would contribute to the total body dose of the terrestrial surrogate species (i.e., muskrat, raccoon, heron, and duck). The exposure pathways include inhalation of airborne radionuclides, external exposure because of immersion in gaseous effluent plumes, and surface exposure from deposition of iodine and particulates from gaseous effluents. Duke used the calculation methods of dose to the MEI from gaseous effluent releases described in Section 5.9.2 to calculate dose to terrestrial surrogate species, with two modifications (Duke 2009c). One modification increased the ground deposition factors to account for the closer proximity of terrestrial animals to the ground compared with the MEI. The second modification was the assumption that terrestrial surrogate inhalation doses would be similar to inhalation dose for a human infant. The gaseous effluent doses were calculated at the site boundary (0.27 mi northwest of the Lee Nuclear Station site) in estimating terrestrial species doses. Total body dose estimates to the surrogate species from the gaseous pathway are shown in Table 5-10.

5.9.5.3 Summary of Impacts on Biota Other Than Humans

The International Atomic Energy Agency (IAEA 1992) and the NCRP (1991) reported that a chronic dose rate of no greater than 10 mGy/d (1000 mrad/d) to the MEI in a population of aquatic organisms would ensure protection of the population. The IAEA (1992) also concluded that chronic dose rates of 1 mGy/d (100 mrad/d) or less do not appear to cause observable changes in terrestrial animal populations.

Table 5-11 provides a comparison of estimated total body dose rates to surrogate biota species that would be produced by releases from the proposed Lee Nuclear Station Units 1 and 2 to the IAEA/NCRP biota dose guidelines (IAEA 1992; NCRP 1991).

Table 5-11. Comparison of Biota Doses from Proposed Lee Units 1 and 2 to IAEA Guidelines for Biota Protection

Biota	Duke Estimate of Dose to Biota (mrad/d)[(a)]	IAEA/NCRP Guidelines for Protection of Biota Populations (mrad/d)[(b)]
Fish	1.6×10^{-3}	1000
Invertebrate	4.4×10^{-3}	1000
Algae	1.3×10^{-2}	1000
Muskrat	1.6×10^{-2}	100
Raccoon	1.1×10^{-2}	100
Heron	3.0×10^{-2}	100
Duck	1.5×10^{-2}	100

Sources: Duke 2009c, 2013g

(a) Total dose from liquid and gaseous effluents in Table 5-10 converted to mrad/d.

(b) Guidelines in NCRP and IAEA reports expressed in Gy/d (1 mGy/d equals 100 mrad/d).

The maximum total dose from both liquid and gaseous pathways from the bounding calculation is about 11.0 mrad/yr, or about 0.030 mrad/d. Thus, doses to biota calculated by both Duke and the NRC staff are far below the 100 mrad/d (0.1 rad/d) IAEA guidelines (IAEA 1992) for terrestrial biota and the 1000 mrad/d (1-rad/d) IAEA guideline (IAEA 1992) for aquatic biota. Daily dose rates would not exceed the IAEA guidelines for any surrogate species.

Based on the information provided by Duke and the NRC's independent evaluation, the NRC staff concludes that the radiological impact on biota from the routine operation of the proposed Lee Nuclear Station Units 1 and 2 would be SMALL, and additional mitigation would not be warranted.

5.9.6 Radiological Monitoring

A radiological environmental monitoring program (REMP) is not yet in place for the Lee Nuclear Station site; however, Duke has committed (Duke 2013a) to develop a REMP implementing the guidance of NEI 07-09A (NEI 2009b). The proposed REMP includes monitoring of the airborne exposure pathway, direct exposure pathway, water exposure pathway, and aquatic exposure pathway from the Broad River, and ingestion exposure pathways within a 5-mi radius of the Lee Nuclear Station, with indicator locations near the plant perimeter and control locations at distances greater than 10 mi. Milk would also be sampled from dairy cows within 5 mi of the Lee Nuclear Station. An annual survey is planned for the area surrounding the site to verify the accuracy of assumptions used in the analyses, including milk production. A preoperational REMP would sample various media in the environment to determine a baseline from which to observe the magnitude and fluctuation of radioactivity in the environment once the units begin operation. The preoperational program would include collection and analysis of samples of air particulates, precipitation, crops, soil, well water, surface water, fish, and silt as well as measurement of ambient gamma radiation. When operation of the proposed Lee Nuclear Station Unit 1 begins, and later when Unit 2 operations begins, the monitoring program would continue to assess the radiological impacts on workers, the public, and the environment. Radiological releases would be summarized in two annual reports: the *Annual Radiological Environmental Operating Report* and *Annual Radioactive Effluent Release Report*. The limits for all radiological releases would be specified in the *Lee Offsite Dose Calculation Manual*, also planned. Duke operates similar radiological monitoring programs at its other reactor sites (e.g., Catawba Nuclear Station, McGuire Nuclear Station); sample analyses would take place at the central Duke laboratory located at the McGuire Nuclear Station site using existing approved methods. In addition, Duke (Duke 2008c) has endorsed the NEI Groundwater Protection Initiative (NEI 2007a). The goals for the Groundwater Protection Initiative will be to provide a hydrologic characterization of the constructed plant and a monitoring well network capable of providing early detection of releases through the use of near-field wells and verification of no offsite migration through the use of far-field wells. Well locations will be selected based on proximity to plant systems that may be a source of radiological releases and/or in nearby projected down-gradient groundwater flow direction from such sources. Where shallow groundwater is expected to be present, shallow wells will be used as first detection monitoring locations. Deeper wells will be used where plant systems are deep. Wells will be installed such that the well screen is located near the potential release location. Deep wells may be located on top of rock or into rock as appropriate. Wells may be paired, either in shallow or deep locations, to evaluate the vertical component of groundwater flow.

5.10 Nonradioactive Waste Impacts

This section describes the potential impacts on the environment that could result from the generation, handling, and disposal of nonradioactive waste and mixed waste during the operation of the proposed Lee Nuclear Station Units 1 and 2. Section 3.4.4 of this EIS describes the nonradioactive waste systems. Types of nonradioactive waste that would be generated, handled, and disposed of during operational activities include solid wastes, liquid effluents, and air emissions. Solid wastes include municipal waste, sewage-treatment sludge, and industrial wastes. Liquid waste includes NPDES-permitted discharges such as effluents containing chemicals or biocides, wastewater effluents, site stormwater runoff, and other liquid wastes such as used oils, paints, and solvents that require offsite disposal. Air emissions would primarily be generated by vehicles and diesel generators. In addition, small quantities of hazardous waste and mixed waste (i.e., waste with both hazardous and radioactive characteristics) may be generated during plant operations. The assessment of potential impacts resulting from these types of wastes is presented in the following sections.

5.10.1 Impacts on Land

Operational solid wastes such as office waste, cardboard, wood, metal, and organic debris from the intake screens would be transported offsite to be recycled or disposed of in an SCDHEC-permitted landfill (Duke 2009c). Waste from the sanitary and potable water systems will be discharged offsite to the Gaffney Board of Public Works Wastewater Treatment Plant (Duke 2009c). Duke expects to produce less than 220 lb of hazardous waste in any calendar month, thus classifying Lee Nuclear Station as a Conditional Exempt Small Quantity Generator under the Resource Conservation and Recovery Act (RCRA). Duke would follow applicable Federal, State, and local requirements and standards for handling, transporting, and disposing of solid waste, including hazardous wastes (Duke 2009c).

Based on Duke’s plans to manage solid and liquid wastes in a similar manner in accordance with all applicable Federal, State, and local requirements and standards, and the effective practices for reusing, recycling, and minimizing waste, the review team expects that impacts on land from nonradioactive wastes generated during the operation of Lee Nuclear Station Units 1 and 2 would be minimal, and no further mitigation would be warranted.

5.10.2 Impacts on Water

Water withdrawn from the Broad River for cooling and other operational purposes for the proposed Lee Nuclear Station Units 1 and 2 would be discharged to the Ninety-Nine Island Reservoir. These discharges would contain both chemicals and biocides and would be controlled by the NPDES permit administered by the SCDHEC. Site stormwater is another potential nonradioactive liquid effluent from the operation of the proposed Units 1 and 2 that would be regulated by the NPDES permit (Duke 2009c). In all cases, the NPDES permit would limit the volume and constituents concentrations in these effluents. Sections 5.2.3.1 and 5.2.3.2 of this EIS discuss impacts on surface and groundwater quality from operation of the proposed Lee Nuclear Station Units 1 and 2. As noted above, wastewater from the sanitary and potable water systems will be discharged offsite to the Gaffney Board of Public Works Wastewater Treatment Plant (Duke 2009c).

Based on the regulated practices for managing liquid discharges containing chemicals or biocides, wastewater, and the plans for managing stormwater, the review team expects that impacts on water from nonradioactive effluents during operation of Lee Nuclear Station Units 1 and 2 would be minimal, and no further mitigation would be warranted.

5.10.3 Impacts on Air

Operation of the proposed Lee Nuclear Station Units 1 and 2 would result in gaseous emissions from operation of emergency diesel generators. Impacts on air quality are discussed in Section 5.7.2 of this EIS. In addition, vehicular traffic associated with personnel necessary to operate the proposed Lee Nuclear Station Units 1 and 2 would increase vehicle emissions in the area. An air emissions operating permit would be required for the purposes of Title V of the Clean Air Act. However, Lee Nuclear Station may be classifiable as a non-Title V conditional/ synthetic minor facility. Under new South Carolina New Source Review (NSR) rules, a regulatory analysis with appropriate calculations would be performed to determine whether NSR/Prevention of Significant Deterioration is applicable (Duke 2009c).

Based on the regulated practices for managing air emissions from stationary sources, the review team expects that impacts on air from nonradioactive emissions during the operation of proposed Lee Nuclear Station Units 1 and 2 would be minimal, and no further mitigation would be warranted.

5.10.4 Mixed-Waste Impacts

Mixed waste contains both low-level radioactive waste and hazardous waste. The generation, storage, treatment, or disposal of mixed waste is regulated by the Atomic Energy Act; the Solid Waste Disposal Act of 1965, as amended by RCRA; and the Hazardous and Solid Waste Amendments (which amended RCRA in 1984). Duke would implement a waste-minimization plan to reduce the amount of mixed waste produced onsite by reducing generation at the source, recycling, and treatment options (Duke 2009c). Duke stated that it would manage the treatment, storage, and offsite disposal of mixed wastes generated by the proposed Units 1 and 2 in accordance with applicable NRC, EPA, and South Carolina regulations (Duke 2009c).

Based on Duke's plan for waste minimization, management, and treatment of mixed wastes in accordance with all applicable Federal, State, and local requirements and standards, the review team expects that impacts from the generation of mixed waste at the proposed Lee Nuclear Station Units 1 and 2 would be minimal, and no further mitigation would be warranted.

5.10.5 Summary of Nonradioactive Waste Impacts

Solid, liquid, gaseous, and mixed wastes generated during operation of the proposed Lee Nuclear Station Units 1 and 2 would be handled according to county, State, and Federal regulations. County and State permits and regulations for handling and disposal of solid waste would be obtained and implemented. Discharges to the Ninety-Nine Islands Reservoir of liquid effluents generated by operations, including wastewater and stormwater, would be controlled and limited by the site NPDES permit. Air emissions from the proposed Lee Nuclear Station Units 1 and 2 operations would be compliant with local, State, and Federal air-quality standards and regulations. Mixed-waste generation, storage, and disposal impacts during operation of the proposed Lee Nuclear Station Units 1 and 2 would be compliant with NRC, EPA, and South Carolina requirements and standards.

Based on the information provided by Duke; implementation of effective practices for recycling, minimizing, managing, and waste disposal at the Lee Nuclear Station site; expectation that regulatory approvals would be obtained to regulate the additional waste that would be generated from proposed Units 1 and 2; and the independent evaluations as discussed in the referenced sections of this EIS, the review team concludes that the potential impacts from nonradioactive waste resulting from the operation of the Lee Nuclear Station site would be SMALL, and no further mitigation would be warranted.

Cumulative impacts on water and air from nonradiological effluents and emissions are discussed in Sections 7.2 and 7.6, respectively. For the purposes of Chapter 9, the review team expects no substantive differences between the impacts of nonradiological waste for the proposed Units 1 and 2 and the alternative sites, and no substantive cumulative impacts that warrant further discussion beyond those discussed for the alternative sites in Section 9.3.

5.11 Environmental Impacts of Postulated Accidents

The NRC staff considered the radiological consequences on the environment of potential accidents at the proposed Lee Nuclear Station. Duke based its COL application on the proposed installation of AP1000 reactors for Units 1 and 2. On December 30, 2011, Revision 19 of the AP1000 design (Westinghouse 2011) was certified in a design certification amendment (76 FR 82079). The Duke application references Revision 19 of the AP1000 DCD.

The term "accident," as used in this section, refers to any off-normal event not addressed in Section 5.9 that results in release of radioactive materials into the environment. The focus of this review is on events that could lead to releases substantially greater than permissible limits for normal operations. Normal release limits are specified in 10 CFR Part 20, Appendix B, Table 2.

Many safety features combine to reduce the risk associated with accidents at nuclear power plants. Safety features in the design, construction, and operation of the plants, which comprise the first line of defense, are intended to prevent the release of radioactive materials from nuclear plants. The design objectives and the measures for keeping levels of radioactive materials in effluents to unrestricted areas ALARA are specified in 10 CFR Part 50, Appendix I. Additional measures are designed to mitigate the consequences of failures in the first line of defense. These include the NRC's reactor site criteria in 10 CFR Part 100 that require the site to have certain characteristics that reduce the risk to the public and the potential impacts of an accident; emergency preparedness plans and protective action measures for the site and environs, as set forth in 10 CFR 50.47, 10 CFR Part 50, Appendix E, and NUREG-0654/FEMA-REP-1 (NRC 1980). All of these safety features, measures, and plans make up the defense-in-depth philosophy to protect the health and safety of the public and the environment.

On March 11, 2011, and for an extended period thereafter, several nuclear power plants in Japan experienced the loss of important equipment necessary to maintain reactor cooling after the combined effects of severe natural phenomena (i.e., an earthquake followed by the tsunami it caused). In response to these events, the Commission established a task force to review the current regulatory framework in place in the United States and to make recommendations for improvements. The task force reported the results of its review (NRC 2011e) and presented its recommendations to the Commission on July 12 and July 19, 2011, respectively. As part of the short-term review, the task force concluded that while improvements are expected to be made as a result of the lessons learned, the continued operation of nuclear power plants and licensing activities for new plants did not pose an imminent risk to public health and safety. A number of areas were recommended to the Commission for long-term consideration. Collectively, these recommendations are intended to clarify and strengthen the regulatory framework for protection against severe natural phenomena, mitigation of the effects of such events, coping with emergencies, and improving the effectiveness of NRC programs. By nature of the passive design and inherent 72-hour coping capability for core, containment, and spent fuel pool cooling with no operator action required, the AP1000 design has many of the design features and attributes necessary to address the Task Force Recommendations (NRC 2011e).

On March 12, 2012, the NRC issued three orders and a request for information (RFI) to holders of U.S. commercial nuclear reactor licenses and construction permits to enhance safety at

U.S. reactors based on specific lessons learned from the event at Japan's Fukushima Dai-ichi nuclear power plant as identified in the task force report.

The first and third orders apply to every U.S. commercial nuclear power plant, including recently licensed new reactors. The first order requires a three-phase approach for mitigating beyond-design-basis external events. Licensees are required to use installed equipment and resources to maintain or restore cooling of the core, containment, and spent fuel during the initial phase. (For the AP1000 design, this is the first 72 hours.) During the transition phase (the next 4 days), licensees are required to provide portable, onsite equipment and consumables sufficient to maintain or restore these functions until they can be accomplished with resources brought from offsite. During the final phase (after 7 days), licensees are required to obtain sufficient offsite resources to sustain those functions indefinitely (77 FR 16091). The second order requires reliable hardened vent systems at boiling water reactor facilities with "Mark I" and "Mark II" containment structures (77 FR 16098). The third order requires reliable spent fuel pool level instrumentation (77 FR 16082). The RFI addressed five topics: (1) seismic reevaluations, (2) flooding reevaluations, (3) seismic hazard walkdowns, (4) flooding hazard walkdowns, and (5) a request for licensees to assess their current communications system and equipment under conditions of onsite and offsite damage and prolonged station blackout and perform a staffing study to determine the number and qualifications of staff required to fill all necessary positions in response to a multi-unit event (NRC 2012e, f). The RFI requested reactor licensees to reevaluate seismic and flooding hazards using methods to determine if the plants' design to be changed.

The NRC staff issued RAIs to Duke requesting information to address the requirements of the first and third orders, and information sought in the first and fifth RFI topics (NRC 2012g). Duke addressed the first and third orders along with the fifth RFI by proposing license conditions to be implemented prior to initial fuel load (Duke 2012p). The AP1000 containment design differs from those identified in the second order; therefore, the actions addressed in this order are not applicable to the Lee Nuclear Station site. The NRC's evaluation of Duke's responses will be addressed in the NRC's Final Safety Evaluation Report (FSER) and any changes to the COL application that are deemed necessary will be incorporated into the applicant's FSAR.

The severe accident evaluation presented later in this section draws from the analyses developed in the NRC staff's safety review, which includes consideration of severe accidents initiated by external events and those that involve fission product releases. The staff evaluation discusses the environmental impacts of severe accidents in terms of risk, which considers both the likelihood of a severe accident and its consequences. For reasons discussed below, the staff has determined that the Fukushima accident and the NRC's implementation of the task force recommendations do not change the staff's conclusions on the environmental impacts of design basis accidents or severe accidents. These conclusions are based on *William States Lee III Nuclear Station COL Final Safety Analysis Report, Revision 5*, which was submitted to the NRC by a letter dated April 16, 2012 (Duke 2012q). Since then, Duke has indicated that changes will be made to the site grading and footprint of the nuclear island which are integral parts of the design basis flood for the proposed Lee Nuclear Station Units 1 and 2 (Duke 2012l).

Each new reactor application evaluates the natural phenomena that are pertinent to the site for the proposed reactor design by applying present-day regulatory guidance and methodologies. This includes a determination of the characteristics of the flood and seismic hazards. With respect to flooding, Duke documented the flood hazard in the FSAR consistent with present-day guidance and methodologies. In support of changes to the site footprint identified by Duke (Duke 2013a), the final flood hazard analysis was submitted by Duke as part of Revision 7 of the FSAR and is currently under review by the NRC. The NRC staff is performing a review and confirmatory analysis to verify that the reconfigured site layout and resulting flood levels conform to the referenced AP1000 maximum flood level plant parameter.

With respect to the consideration of severe accidents initiated by seismic events, Duke is currently developing its response to the staff's seismic hazard RAI stemming from the first RFI topic (NRC 2012g). The RAI requested that Duke evaluate the impact of the latest information affecting seismic hazard analysis (SHA) for the central and eastern United States. In response to the staff's RAI, Duke is re-evaluating its SHA and performing new calculations (Duke 2012r, 2012s). The NRC considering all possible outcomes of the SHA analysis for the Lee Nuclear Station site. The NRC staff will review Duke's results and RAI response to ensure they meet all applicable regulatory requirements. Duke will need to demonstrate and the NRC staff will confirm that the AP1000 seismic design response spectra are acceptable at the Lee Nuclear Station site. After the final SHA results are submitted by Duke to the NRC for review, the NRC staff will evaluate its impact to determine if Duke would be required to modify the plant design to ensure any change in the seismic hazard can be accounted for with acceptable design margin.

In addition to the above considerations for seismic and flooding, the safety features of the AP1000 design support the conclusion that the Fukushima accident does not warrant a change in the assessment of environmental risks from severe accidents considered in the Lee Nuclear Station EIS analysis. In particular, the potential design-related vulnerabilities raised by the event at Fukushima, such as the impact of the extended loss of alternating-current electric power on core cooling systems, would not materially affect the analysis of severe accidents for Lee because the AP1000 has been designed to prevent and mitigate severe accidents given a loss of all alternating-current electrical power sources. As previously noted in the task force report, on loss of alternating-current electrical power, the AP1000 passive safety systems would remove the decay heat from the reactor core and spent fuel. They will maintain adequate core cooling for a period of 72 hours without further operator action, unlike the facilities at the Fukushima site. This core cooling by the passive safety systems can be sustained for an extended period beyond 72 hours where the only operator actions are to refill the tank that is the source of water for the passive safety systems and distribute the water when needed.

Additional details are provided in the staff's safety evaluation report for the AP1000 design certification. The NRC staff's design certification review (76 FR 82079) regarding the safety of the AP1000 design concluded that the design has a very high capacity to withstand beyond-design-basis events.

In summary, none of the information the staff has identified about the Fukushima accident or the steps taken by the NRC to date to implement the task force recommendations suggests that the seismic and flooding hazards or the available mitigation capability assumed in the Lee Nuclear Station EIS analysis of severe accidents would be affected. For these reasons, the NRC's analysis of the environmental impacts of design basis and severe accidents presented herein remains valid.

This section discusses (1) the types of radioactive materials, (2) the paths to the environment, (3) the relationship between radiation dose and health effects, and (4) the environmental impacts of reactor accidents, both design basis accidents (DBAs) and severe accidents. The environmental impacts of accidents during transportation of spent fuel are discussed in Chapter 6.

The potential for dispersion of radioactive materials in the environment depends on the mechanical forces that physically transport the materials and on the physical and chemical forms of the material. Radioactive material exists in a variety of physical and chemical forms. The majority of the material in the fuel is in the form of nonvolatile solids. However, a significant amount of material is in the form of volatile solids or gases. The gaseous radioactive materials include the chemically inert noble gases (e.g., krypton and xenon), which have a high potential for release. Radioactive forms of iodine, which are created in substantial quantities in the fuel by fission, are volatile. Other radioactive materials formed during the operation of a nuclear power plant have lower volatilities and therefore lower tendencies to escape from the fuel than the noble gases and iodines.

Radiation dose to individuals is determined by their proximity to radioactive material; amount of radioactive material inhaled, ingested, or absorbed through the skin; the duration of their exposure; and the extent to which they are shielded from the radiation. Predominant pathways that lead to radiation exposure include (1) external radiation from radioactive material in the air, on the ground, and in the water; (2) inhalation of radioactive material; and (3) ingestion of food or water containing material initially deposited on the ground and in water.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A report by the National Research Council (2006), the BEIR VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the

NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks.

Physiological effects are clinically detectable if individuals receive radiation exposure resulting in a dose greater than about 25 rem over a short period of time (hours). Doses of about 250 to 500 rem received over a relatively short period (hours to a few days) can be expected to cause some fatalities.

5.11.1 Design Basis Accidents

Duke evaluated the potential consequences of postulated accidents to demonstrate that an AP1000 reactor could be constructed and operated at the Lee Nuclear Station site without undue risk to the health and safety of the public (Duke 2009c). These evaluations used site-specific meteorological data and a set of surrogate DBAs that are representative for the reactor design being considered for the Lee Nuclear Station. The set of accidents covers events that range from relatively high probability of occurrence with relatively low consequences to relatively low probability with high consequences.

The DBA review focuses on the AP1000 reactors at the Lee Nuclear Station site. The bases for analyses of postulated accidents for this design are well established because they have been considered as part of the NRC's reactor design-certification process. Potential consequences of DBAs are evaluated following procedures outlined in regulatory guides and standard review plans. The potential consequences of accidental releases depend on the specific radionuclides released, the amount of each radionuclide released, and the meteorological conditions. The source terms for the AP1000 reactor and methods for evaluating potential accidents are based on guidance in Regulatory Guide 1.183 (NRC 2000b).

For environmental reviews, consequences are evaluated assuming realistic meteorological conditions. Meteorological conditions are represented in these consequence analyses by an atmospheric dispersion factor, which is also referred to as relative concentration (χ/Q; units of s/m^3). Acceptable methods of calculating χ/Q for DBAs from meteorological data are set forth in Regulatory Guide 1.145 (NRC 1983).

Table 5-12 lists χ/Q values the NRC staff considers pertinent to the environmental review of DBAs for the Lee Nuclear Station. Smaller χ/Q values are associated with greater dilution capability. The first column in Table 5-12 identifies the time periods and boundaries for which χ/Q and dose estimates are needed. For the EAB, the postulated DBA dose and its atmospheric dispersion factor are calculated for a short-term period (i.e., 2 hours). For the low-population zone (LPZ), they are calculated for the course of the accident (i.e., 30 days composed of four time periods). The second column in Table 5-12 lists the corresponding χ/Q values for the Lee Nuclear Station site (Duke 2013c); these values were calculated using

2 years of onsite meteorological data (December 1, 2005, to November 30, 2007) assuming a 448-ft release boundary around each reactor. The values listed in Table 5-12 represent the highest χ/Qs for a given time period selected from the individual analyses for the proposed Units 1 and 2. Credit was taken for enhanced dispersion due to building wake effects. The NRC staff completed an independent evaluation of the χ/Q values and found similar results.

Table 5-12. Atmospheric Dispersion Factors for Lee Nuclear Station Site DBA Calculations

Time Period and Boundary	χ/Q (s/m^3)
0 to 2 hr, exclusion area boundary	8.30×10^{-5}
0 to 8 hr, low-population zone	8.80×10^{-6}
8 to 24 hr, low-population zone	7.51×10^{-6}
1 to 4 d, low-population zone	5.33×10^{-6}
4 to 30 d, low-population zone	3.25×10^{-6}

Source: Duke 2013c

Table 5-13 lists the set of DBAs considered by Duke and presents estimates of the environmental consequences of each accident in terms of total effective dose equivalent (TEDE). TEDE is estimated by the sum of the committed effective dose equivalent from inhalation and the deep dose equivalent from external exposure. Dose conversion factors from Federal Guidance Report 11 (Eckerman et al. 1988) were used to calculate the committed effective dose equivalent. Similarly, dose conversion factors from Federal Guidance Report 12 (Eckerman and Ryman 1993) were used to calculate the deep dose equivalent.

The NRC staff reviewed Duke's selection of DBAs by comparing the accidents listed in the application with the DBAs considered in the AP1000 DCD. The DBAs in Duke's ER are the same as those considered in Revision 17 (Westinghouse 2008) and also Revision 19 of the DCD (Westinghouse 2011). The NRC concludes that the set of DBAs in Duke's ER is appropriate.

The review criteria used in the NRC's safety review of DBA doses are included in Table 5-13 to illustrate the magnitude of the calculated environmental consequences (TEDE doses) because no environmental criteria exist related to potential consequences of DBAs. In all cases, the calculated TEDE values are considerably smaller than those used as safety review criteria.

The NRC reviewed the DBA analysis in Duke's ER, which is based on analyses performed for design certification of Revision 17 of the AP1000 reactor design with adjustments for site-specific characteristics at the Lee Nuclear Station. The NRC staff also performed an independent DBA analysis with consideration of both Revision 17 and Revision 19 of the AP1000 DCD. The results of the Duke and NRC staff analyses indicate that the environmental risks associated with DBAs from an AP1000 reactor built at the Lee Nuclear Station site would be small. On this basis, the staff concludes that the environmental consequences of DBAs at the Lee Nuclear Station site would be SMALL for an AP1000 reactor.

Table 5-13. Design Basis Accident Doses for a Lee Nuclear Station AP1000 Reactor

Accident	Standard Review Plan Section(b)	TEDE in rem(a)		
		EAB(c)	LPZ(d)	Review Criterion
Main steam line break	15.1.5			
Pre-existing iodine spike		8.3×10^{-2}	1.6×10^{-2}	$2.5 \times 10^{+1}$(e)
Accident-initiated iodine spike		9.1×10^{-2}	4.6×10^{-2}	$2.5 \times 10^{+0}$(f)
Steam generator rupture	15.6.3			
Pre-existing iodine spike		1.8×10^{-1}	2.2×10^{-2}	$2.5 \times 10^{+1}$(e)
Accident-initiated iodine spike		9.1×10^{-2}	1.5×10^{-2}	$2.5 \times 10^{+0}$(f)
Loss-of-coolant accident	15.6.5	$4.0 \times 10^{+0}$	9.4×10^{-1}	$2.5 \times 10^{+1}$(e)
Rod ejection	15.4.8	3.0×10^{-1}	1.0×10^{-1}	$6.25 \times 10^{+0}$(f)
Reactor coolant pump rotor seizure (locked rotor)	15.3.3			
No feedwater		6.6×10^{-2}	6.8×10^{-3}	$2.5 \times 10^{+0}$(f)
Feedwater available		5.0×10^{-2}	1.4×10^{-2}	$2.5 \times 10^{+0}$(f)
Failure of small lines carrying primary coolant outside containment	15.6.2	1.7×10^{-1}	1.8×10^{-2}	$2.5 \times 10^{+0}$(f)
Fuel handling	15.7.4	4.3×10^{-1}	4.6×10^{-2}	$6.25 \times 10^{+0}$(f)

Source: Duke 2013c
(a) To convert rem to Sv, divide by 100.
(b) NUREG-0800 (NRC 2007c).
(c) EAB = exclusion area boundary.
(d) LPZ = low-population zone.
(e) 10 CFR 52.79 (a)(1) and 10 CFR 100.21 criteria.
(f) Standard Review Plan 15.0.3 criterion (NRC 2007c).

5.11.2 Severe Accidents

In its ER (Duke 2009c), Duke considers the potential consequences of severe accidents for an AP1000 reactor at the Lee Nuclear Station site. Three pathways are considered: (1) the atmospheric pathway in which radioactive material is released to the air; (2) the surface-water pathway in which airborne radioactive material falls out on open bodies of water; and (3) the groundwater pathway in which groundwater is contaminated by a basemat melt-through with subsequent contamination of surface water by the groundwater.

Duke's consequence assessment is based on the probabilistic risk assessment (PRA) for Revision 15 of the AP1000 design (Westinghouse 2005), which is certified in 10 CFR Part 52,

Appendix D. Westinghouse subsequently upgraded and updated the PRA model; however, Westinghouse reviewed the AP1000 probabilistic risk assessment for Revision 15 and concluded that the PRA remains valid for proposed revisions to the DCD (Westinghouse 2010b). The NRC staff evaluated the current PRA model and its results using "Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications" (DC/COL-ISG-3; NRC 2008g), and concluded that the Revision 15 results remain conservative and are an acceptable basis for evaluating severe accidents and strategies for mitigating them. Duke is required by regulation to upgrade and update the PRA prior to fuel loading. At that time, the NRC staff expects the PRA to be site-specific and that it will no longer use the bounding assumptions of the design-specific PRA.

Duke's (Duke 2009c) evaluation of the potential environmental consequences for the atmospheric and surface-water pathways incorporates the results of the MELCOR Accident Consequence Code System (MACCS2) computer code Version 1.12 (Chanin and Young 1998) run using AP1000 reactor source-term information and Lee Nuclear Station site-specific meteorological, population, and land-use data. Duke provided the NRC staff with copies of the input and output files for the MACCS2 computer runs (Duke 2008h). The NRC staff reviewed the files, ran confirmatory calculations, and determined that Duke's results are reasonable.

The MACCS computer codes were developed to evaluate the potential offsite consequences of severe accidents for the sites covered by NUREG-1150 (NRC 1990). The MACCS2 codes evaluate the consequences of atmospheric releases of material after a severe accident. The pathways modeled include exposure to the passing plume, exposure to material deposited on the ground and skin, inhalation of material in the passing plume and re-suspended from the ground, and ingestion of contaminated food and surface water.

Three types of severe accident consequences were assessed in the MACCS analysis: (1) human health, (2) economic costs, and (3) land area affected by contamination. Human health effects are expressed in terms of the number of cancers that might be expected if a severe accident were to occur. These effects are directly related to the cumulative radiation dose received by the general population. MACCS2 estimates both early fatalities and latent cancer fatalities. Early fatalities are related to high doses or dose rates and can be expected to occur within a year of exposure (Jow et al. 1990). Latent fatalities are related to exposure of a large number of people to low doses and dose rates and can be expected to occur after a latent period of several (2 to 15) years. Population health-risk estimates are based on the population distribution within a 50-mi radius of the site. Economic costs of a severe accident include costs associated with short-term relocation of people; decontamination of property and equipment; interdiction of food supplies, land, and equipment use; and condemnation of property. The affected land area is a measure of the areal extent of the residual contamination following a severe accident. Farmland decontamination is an estimate of the area that has an average whole body dose rate for the 4-year period following the release that would be greater than

0.5 rem/year if not reduced by decontamination and that would have a dose rate following decontamination of less than 0.5 rem/year. Decontaminated land is not necessarily suitable for farming.

Risk is the product of the frequency and the consequences of an accident. For example, the probability of a severe accident without loss of containment for an AP1000 reactor at the Lee Nuclear Station is estimated to be 2.2×10^{-7}/ Ryr, and the cumulative population dose associated with a severe accident without loss of containment at the site is calculated to be 5.2×10^{3} person-rem (Duke 2009c). The population dose risk for this class of accidents is the product of 2.2×10^{-7}/Ryr and 5.2×10^{3} person-rem, or 1.2×10^{-3} person-rem/Ryr. The following sections discuss the estimated risks associated with each pathway.

The risks presented in the tables that follow are risks per year of reactor operation. Duke indicated that the Lee Nuclear Station site will have two AP1000 reactors. The consequences of a severe accident would be the same regardless of whether one or two AP1000 reactors were built at the Lee Nuclear Station site. If two AP1000 reactors were built, the risks would apply to each reactor, and the total risk for reactors at the site would be double the risk for a single reactor. A discussion of these risks is presented in the following sections.

5.11.2.1 Air Pathway

The MACCS2 code directly estimates consequences of releases to the air pathway. The risk calculated from the results of the MACCS2 runs are presented in Table 5-14. The core damage frequencies (CDFs) given in the following tables are for internally initiated accident sequences while the plant is at power. Internally initiated accident sequences include sequences that are initiated by human error, equipment failures, loss of offsite power, etc. Estimates of the CDFs for externally initiated events and during shutdown are discussed later.

Table 5-14 shows that the probability-weighted consequences (i.e., risks) of severe accidents for an AP1000 reactor located on the Lee Nuclear Station site are small for all risk categories considered. For perspective, Table 5-15 and Table 5-16 compare the health risks from severe accidents for an AP1000 reactor at the Lee Nuclear Station site with the risks for current-generation reactors at various sites and with health risks for AP1000 reactors at the North Anna, Clinton, Grand Gulf, and Vogtle sites.

In Table 5-15, the health risks estimated for an AP1000 reactor at the Lee Nuclear Station site are compared with health-risk estimates for the five reactors considered in NUREG-1150 (NRC 1990). Although risks associated with both internally and externally initiated events were considered for the Peach Bottom and Surry reactors in NUREG-1150, only internally initiated events are presented in Table 5-16. Table 5-16 also compares the health risks of an AP1000 reactor at the Lee Nuclear Station site with the health risks of an AP1000 reactor at four early-site-permit sites (Duke 2009c; NRC 2006a, b, c, 2008c).

Table 5-14. Mean Environmental Risks from an AP1000 Reactor Severe Accident at the Lee Nuclear Station Site

	Release Category Description (Accident Class)	Core Damage Frequency (per Ryr)	Environmental Risk					
			Population Dose (person-rem/Ryr)(a)	Fatalities (per Ryr) Early(b,f)	Fatalities (per Ryr) Latent(c)	Cost(d) ($/Ryr)	Farm Land Decontamination(e) (ha/Ryr)	Population Dose from Water Ingestion (person-rem/Ryr)(a)
IC	Intact containment	2.2×10^{-7}	1.2×10^{-3}	0.0	5.6×10^{-7}	0.97	1.1×10^{-5}	3.3×10^{-6}
BP	Containment bypass, fission products released directly to environment	1.1×10^{-8}	3.6×10^{-2}	5.5×10^{-10}	2.4×10^{-5}	118.00	9.1×10^{-4}	1.3×10^{-3}
CI	Containment isolation failure occurs prior to onset of core damage	1.3×10^{-9}	1.7×10^{-3}	0.0	1.4×10^{-6}	4.30	5.9×10^{-5}	3.6×10^{-5}
CFE	Early containment failure, after onset of core damage but before core relocation	7.5×10^{-9}	1.4×10^{-2}	0.0	7.9×10^{-6}	31.00	4.0×10^{-4}	2.0×10^{-4}
CFI	Intermediate containment failure, after core relocation but before 24 hr	1.9×10^{-10}	2.9×10^{-4}	0.0	2.4×10^{-7}	0.90	8.2×10^{-6}	3.7×10^{-6}
CFL	Late containment failure occurring after 24 hr	3.5×10^{-13}	7.9×10^{-7}	0.0	1.1×10^{-9}	0.004	2.3×10^{-8}	8.4×10^{-10}
Total		2.4×10^{-7}	5.3×10^{-2}	5.5×10^{-10}	3.4×10^{-5}	155.17	1.4×10^{-3}	1.5×10^{-3}

(a) To convert person-rem to person-Sv, divide by 100.
(b) Early fatalities are fatalities related to high doses or dose rates that generally can be expected to occur within a year of the exposure (Jow et al. 1990).
(c) Latent fatalities are fatalities related to low doses or dose rates that can be expected to occur after a latent period of several (2 to 15) years.
(d) Cost risk includes costs associated with short-term relocation of people, decontamination, interdiction, and condemnation. It does not include costs associated with health effects (Jow et al. 1990).
(e) Land risk is an area where the average whole body dose rate for the 4-yr period following the accident exceeds 0.5 rem/yr but can be reduced to less than 0.5 rem/yr by decontamination.
(f) The NRC staff examined the early fatalities for the Lee Nuclear Station site using both a two-plume and four-plume segment model for MACCS2. The values listed are for the four-plume segment model.

Table 5-15. Comparison of Environmental Risks for an AP1000 Reactor at the Lee Nuclear Station Site with Risks for Current-Generation Reactors at Five Sites Evaluated in NUREG-1150 and for the AP1000 Reactor at Four Sites

	Core Damage Frequency (per Ryr)	50-mi Population Dose Risk (person-rem/Ryr)[(a)]	Fatalities per Ryr		Average Individual Fatality Risk (per Ryr)	
			Early	Latent	Early	Latent Cancer
Grand Gulf[(b)]	4.0×10^{-6}	5×10^{1}	8×10^{-9}	9×10^{-4}	3×10^{-11}	3×10^{-10}
Peach Bottom[(b)]	4.5×10^{-6}	$7 \times 10^{+2}$	2×10^{-8}	5×10^{-3}	5×10^{-11}	4×10^{-10}
Sequoyah[(b)]	5.7×10^{-5}	$1 \times 10^{+3}$	3×10^{-5}	1×10^{-2}	1×10^{-8}	1×10^{-8}
Surry[(b)]	4.0×10^{-5}	$5 \times 10^{+2}$	2×10^{-6}	5×10^{-3}	2×10^{-8}	2×10^{-9}
Zion[(b)]	3.4×10^{-4}	$5 \times 10^{+3}$	4×10^{-5}	2×10^{-2}	9×10^{-9}	1×10^{-8}
AP1000[(c)] Reactor at the Lee Nuclear Station site	2.4×10^{-7}	5.3×10^{-2}	5.5×10^{-10}	3.4×10^{-5}	0.0	3.0×10^{-11}
AP1000[(d)] Reactor at North Anna	2.4×10^{-7}	8.3×10^{-2}	1.2×10^{-10}	4.0×10^{-5}	2.6×10^{-13}	4.9×10^{-11}
AP1000[(e)] Reactor at Clinton	2.4×10^{-7}	2.2×10^{-2}	1.4×10^{-8}	1.2×10^{-5}	6.4×10^{-13}	5.5×10^{-11}
AP1000[(f)] Reactor at Grand Gulf	2.4×10^{-7}	1.4×10^{-2}	$< 1.0 \times 10^{-12}$	6.9×10^{-6}	$<1.0 \times 10^{-14}$	2.0×10^{-11}
AP1000[(g)] Reactor at the Vogtle Electric Generating Plant site	2.4×10^{-7}	2.8×10^{-2}	1.9×10^{-10}	1.9×10^{-5}	1.6×10^{-12}	1.1×10^{-11}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Risks were calculated using the MACCS code and presented in NUREG-1150 (NRC 1990).
(c) Calculated with MACCS2 code using Lee Nuclear Station site-specific input.
(d) NUREG-1811 (NRC 2006a).
(e) NUREG-1815 (NRC 2006b).
(f) NUREG-1817 (NRC 2006c).
(g) NUREG-1872 (NRC 2008h).

Table 5-16. Comparison of Environmental Risks from Severe Accidents Initiated by Internal Events for an AP1000 Reactor at the Lee Nuclear Station Site with Risks Initiated by Internal Events for Current Nuclear Power Plants Undergoing Operating License Renewal Review and Environmental Risks of the AP1000 Reactor at Other Sites

	Core Damage Frequency (per Ryr)	50-mi Population Dose Risk (person-rem/Ryr)[(a)]
Current Reactor Maximum[(b)]	2.4×10^{-4}	6.9×10^{1}
Current Reactor Mean[(b)]	2.7×10^{-5}	1.6×10^{1}
Current Reactor Median[(b)]	1.6×10^{-5}	1.3×10^{1}
Current Reactor Minimum[(b)]	1.9×10^{-6}	3.4×10^{-1}
AP1000[(c)] Reactor at Lee	2.4×10^{-7}	5.3×10^{-2}
AP1000[(d)] Reactor at North Anna	2.4×10^{-7}	8.3×10^{-2}
AP1000[(e)] Reactor at Clinton	2.4×10^{-7}	2.2×10^{-2}
AP1000[(f)] Reactor at Grand Gulf	2.4×10^{-7}	1.4×10^{-2}
AP1000[(g)] Reactor at Vogtle	2.4×10^{-7}	2.8×10^{-2}

(a) To convert person-Sv to person-rem, multiply by 100.
(b) Based on MACCS and MACCS2 calculations for over 70 current plants at over 40 sites.
(c) Calculated with MACCS2 code using Lee Nuclear Station site-specific input.
(d) NUREG-1811 (NRC 2006a).
(e) NUREG-1815 (NRC 2006b).
(f) NUREG-1817 (NRC 2006c).
(g) NUREG-1872 (NRC 2008h).

The last two columns of Table 5-15 provide average individual fatality risk estimates. To put these estimates into context for the environmental analysis, the staff compares these estimates to the safety goals. The Commission has set safety goals for average individual early fatality and latent cancer fatality risks from reactor accidents in the Safety Goal Policy Statement (51 FR 30028). These goals are presented here solely to provide a point of reference for the environmental analysis and do not serve the purpose of a safety analysis. The Safety Goal Policy Statement expressed the Commission's policy regarding the acceptance level of radiological risk from nuclear power plant operation as follows:

- Individual members of the public should be provided a level of protection from the consequences of nuclear power plant operation such that individuals bear no significant additional risk to life and health.
- Societal risks to life and health from nuclear power plant operation should be comparable to or less than the risks of generating electricity by viable competing technologies and should not be a significant addition to other societal risks.

The following quantitative health objectives are used in determining achievement of the safety goals:

- The risk to an average individual in the vicinity of a nuclear power station of prompt fatalities that might result from reactor accidents should not exceed 0.1 of 1 percent (0.1 percent) of the sum of prompt fatality risks resulting from other accidents to which members of the U.S. population are generally exposed.
- The risk to the population in the area near a nuclear power station of cancer fatalities that might result from nuclear power plant operation should not exceed 0.1 of 1 percent (0.1 percent) of the sum of cancer fatality risks resulting from all other causes.

These quantitative health objectives are translated into two numerical objectives as follows:

- The individual risk of a prompt fatality from all "… other accidents to which members of the U.S. population are generally exposed…." is about 4.0×10^{-4}/yr, including a 1.3×10^{-4}/yr risk associated with transportation accidents (NSC 2010). One-tenth of 1 percent of these figures implies that the individual risk of prompt fatality from a reactor accident should be less than 4.0×10^{-7}/Ryr.
- "The sum of cancer fatality risks that result from all other causes" for an individual is taken to be the U.S. cancer fatality rate, which is about 1 in 500 or 2×10^{-3}/yr (Reed 2007). One-tenth of 1 percent of this implies the risk of cancer to the population in the area near a nuclear power plant from its operation should be limited to 2×10^{-6}/Ryr.

MACCS2 calculates average individual early and latent cancer fatality risks. The average individual early fatality risk is calculated using the population distribution within 1 mi of the plant boundary. The average individual latent cancer fatality risk is calculated using the population distribution within 10 mi of the plant. For the plants considered in NUREG-1150, these risks were well below the Commission's safety goals. Risks calculated by Duke for the AP1000 reactor design at the Lee Nuclear Station site are also well below the Commission's safety goals.

The NRC staff compared the CDF and population dose risk estimate for an AP1000 reactor at the Lee Nuclear Station site with statistics summarizing the results of contemporary severe accident analyses performed for over 70 reactors at over 40 sites. The results of these analyses are included in the final site-specific Supplements 1 through 49 to the GEIS for license renewal (NRC 2013a), and in the ERs included with license renewal applications for the plants for which supplements have not been published. All of the analyses were completed after publication of NUREG-1150 (NRC 1990), and the analyses for most of the reactors used MACCS2, which was released in 1997. Table 5-16 shows that the CDFs estimated for the AP1000 reactor are significantly lower than those for current-generation reactors. Similarly, the population doses estimated for an AP1000 reactor at the Lee Nuclear Station site are well below the mean and median values for current-generation reactors undergoing license renewal.

Finally, the population dose risk from a severe accident for an AP1000 reactor at the Lee Nuclear Station site, 5.3×10^{-2} person-rem/Ryr, may be compared with the dose risk for normal operation of a single AP1000 reactor at the Lee Nuclear Station site (4.79 person-rem/Ryr; see Section 5.9.3.2); comparatively, the population dose risk for a severe accident is small.

5.11.2.2 Surface-Water Pathway

Surface-water pathways are an extension of the air pathway. These pathways cover the effects of radioactive material deposited on open bodies of water and include the ingestion of water and aquatic foods as well as water submersion and activities occurring near the water. Of these surface-water pathways, the ingestion of contaminated water was evaluated by the MACCS2 codes. The risks associated with this pathway were calculated for the Lee Nuclear Station and are included in the last column of Table 5-14. The water-ingestion dose risk of 1.5×10^{-3} person-rem/Ryr is small compared to the total population dose risk of 5.3×10^{-2} person-rem/Ryr (Duke 2009c).

Although surface-water pathways beyond water ingestion are not considered in the MACCS2 code, they have been examined in the GEIS for license renewal in the context of renewal of licenses for current-generation reactors (NRC 2013a). The Lee Nuclear Station, which would be situated near the Broad River, can be classified as a small-river site. Table 5.17 in the GEIS indicates that, at small-river sites, water ingestion is the dominant liquid pathway rather than seafood ingestion and shoreline exposure (NRC 1996). In addition, if a severe accident occurred at the Lee Nuclear Station site, it is likely that Federal, State, and local officials would restrict access to the river below the site and in contaminated areas above the site thereby greatly reducing these surface-water pathway exposures. On this basis, the NRC staff believes that the overall surface-water pathway risk remains small when compared to the total population dose risk.

5.11.2.3 Groundwater Pathway

The groundwater pathway involves a reactor core melt, reactor vessel failure, and penetration of the floor (basemat) below the reactor vessel. Ultimately, core debris reaches groundwater where soluble radionuclides are transported with the groundwater. In the GEIS for license renewal (NRC 2013a), the NRC staff assumed that the probability of a severe accident with basemat penetration was 1×10^{-4}/Ryr and concluded that the groundwater-pathway risks were small. The Duke ER summarizes the discussion in the 1996 version of NUREG-1437 (NRC 1996) and reaches the same conclusion.

The NRC staff has re-evaluated its assumption of a 1×10^{-4}/Ryr probability of a basemat melt-through. The NRC staff believes that the 1×10^{-4} probability is too large for new power stations. Design elements have been included in the AP1000 design to minimize the potential for reactor core debris to reach groundwater. These elements include external reactor vessel cooling and ex-vessel core debris cooling. Further, the probability of core melt with a basemat melt-through should be no larger than the total CDF estimate for the reactor. Table 5-16 gives a total CDF estimate of 2.4×10^{-7}/Ryr for the AP1000 reactor. NUREG-1150 (NRC 1990) indicates that the conditional probability of a basemat melt-through ranges from 0.05 to 0.25 for current-generation reactors. If the CDF for AP1000 severe accidents in which containment remains intact are subtracted from the total AP1000 CDF to get the CDF for severe accidents in which basemat melt-through is a possibility, the CDF is on the order of 2×10^{-8}/Ryr. On this basis, the staff believes that a basemat melt-through probability of 2×10^{-8}/Ryr is reasonable and still conservative. The groundwater pathway is also more tortuous and affords more time for implementing protective actions than the air pathway and, therefore, results in a lower risk to the public. As a result, the NRC staff concludes that the risks associated with releases to groundwater are sufficiently small that they would not have a significant effect on the overall plant risk.

5.11.2.4 Externally Initiated Events

The analyses described above are specifically for internally initiated events. Duke’s ER also addresses potential consequences from externally initiated events (Duke 2009c). The AP1000 reactor vendor and the NRC have addressed three externally initiated events during initial design certification of the AP1000 reactor: (1) seismic, (2) internal fire, and (3) internal flooding events. The results of these analyses are described in Section 19.1.5 of the FSER for Revision 15 of the AP1000 DCD (NRC 2004b). While amending the certified design, the seismic hazard was re-evaluated and the seismic margin analysis was revised. The results are described in Revision 19 of the AP1000 design certification document (Westinghouse 2011). The NRC staff’s evaluation is documented in Section 19.55 of Supplement 2 to the AP1000 FSER (NRC 2011g). In addition, high winds, external flooding, transportation-related events, and potential hazards from nearby industrial facilities were assessed. The NRC staff’s evaluation is documented in Section 19.58 of the same supplement.

With respect to seismic events, the AP1000 reactor vendor performed a PRA-based seismic margin analysis. The analysis results indicated that there is high confidence (95 percent) that safety systems and components would survive 0.5-g peak acceleration during a seismic event. The safe-shutdown earthquake for the AP1000 reactor design is 0.3 g. Consequently, the NRC staff concluded in the FSER that the AP1000 reactor design is acceptable (NRC 2004b). After re-evaluating the seismic hazard for the amended design and for a spectrum of site characteristics ranging from soft soil to hard rock and updating the PRA-based seismic margin analysis, Duke reported the same results for the amended design. Consequently, the NRC staff concluded that the amended design is acceptable (NRC 2011g).

With respect to internal fires, the AP1000 reactor vendor estimated the fire-induced CDFs to be about 5.6×10^{-8} yr^{-1} during power operation and about 8×10^{-8} yr^{-1} during shutdown, and considers these estimates to be conservative. While the NRC staff believes that such a conclusion is not possible without a detailed PRA, the NRC staff, in its safety review, concluded that the AP1000 reactor design is capable of withstanding severe accident challenges from internal fires in a manner superior to most, if not all, operating plant designs (NRC 2004b).

With respect to internal flooding, the AP1000 reactor vendor did not perform a detailed PRA to assess the risk from internal flooding. Instead, the vendor performed an internal flooding PRA commensurate with the level of detail available and where detailed information was not available, made conservative assumptions to bound the flooding analysis. In its safety review, the NRC staff found that this analysis was adequate to identify potential vulnerabilities and to lend insight into the design that could be used to support design-certification requirements. Quantification of potential scenarios with the plant at power resulted in a total CDF from internal floods of about 1×10^{-9} yr^{-1}. The CDF from internal floods when the power station is shutdown is estimated to be about 3.2×10^{-9} yr^{-1}. The vendor considers these estimates to be conservative. While the NRC staff believes that such a conclusion is not possible without a detailed PRA, the NRC staff, in its safety review, concluded that the AP1000 reactor design is capable of withstanding severe accident challenges from internal floods in a manner superior to operating plants and is consistent with the conclusions from the vendor's internal flood risk analysis (NRC 2004b).

With respect to high winds, the AP1000 reactor vendor considered extratropical cyclones, hurricanes up to Category 5 on the Saffir-Simpson scale, and tornadoes up to EF5 on the enhanced Fujita scale. For hurricanes and tornadoes, the vendor assumed event frequencies that also bound the corresponding frequencies at the Lee Nuclear Station site. The total contribution of high winds to CDF was reported to be 1.38×10^{-8} yr^{-1}, assuming that only safety systems are available. The NRC staff concluded that, for the Lee Nuclear Station site, the contribution to CDF attributable to high winds is bounded by the contribution reported for the certified design (NRC 2011g).

With respect to external flooding, the AP1000 reactor vendor considered all sources of flooding that could occur at any site and concluded that, as long as floodwaters did not rise to the level of the plant grade, there would be no contribution to CDF. The plant grade at the Lee Nuclear Station site is higher than any floodwaters could reach, even considering maximum precipitation in relevant watersheds, coincident dam failure, and wind-driven wave action. The NRC staff concludes that external flooding has negligible consequences at the Lee Nuclear Station site (NRC 2011g).

With respect to risk from accidents related to transportation and nearby industrial activities, the AP1000 reactor vendor addressed aviation, marine and nearby industrial facilities, pipelines, as well as railroad and truck accidents.

For the frequency of accidental impact by commercial aircraft, the AP1000 reactor vendor assumed that such impacts are of negligible frequency. For general aviation, the frequency of accidental impact was assumed to be higher, but the contribution to CDF is negligible. For the Lee Nuclear Station site, the expected frequency of accidental impact was shown to be less than the frequencies assumed by the vendor. The NRC staff concluded that the risk from accidental aircraft impact on the Lee Nuclear Station site was bounded by the risk reported generically (NRC 2011g).

For marine and nearby facility accidents, the AP1000 reactor vendor considered two hazards: (1) release of hazardous material and (2) explosion. There is no commercial traffic on the Broad River, so marine accidents are not applicable to the Lee Nuclear Station site. In addition, hazardous materials in sufficient quantity to affect control room habitability are not stored within 5 mi of the plant, including materials stored onsite. The NRC staff concluded that marine transportation accidents and accidents in nearby facilities would occur at negligible frequency at the Lee Nuclear Station site (NRC 2011g).

For pipeline accidents, the AP1000 reactor vendor assumed rupture of a 30-in. gas pipe, 5800 ft from the plant and demonstrated that the probability of such a rupture, formation of a flammable gas cloud, transportation to the site without dispersion, and ignition at a location that would challenge plant safety is less than 1×10^{-7} yr^{-1}. Site habitability was also considered even though no operator action is required to prevent core damage. With advanced warning, operators can actuate a passive system for ensuring control room habitability, raising control room pressure above atmospheric and preventing the intrusion of toxic substances. There are no pipelines of comparable size within 5 mi of the Lee Nuclear Station site. The NRC staff concluded that risk from pipelines near the Lee Nuclear Station site was bounded by the risk reported generically (NRC 2011g).

For rail accidents, the safe standoff distance was computed and found to be less than the distance from the Lee Nuclear Station site boundary to the nearest railway. Similarly, for accidents involving a truck, the safe standoff distance is less than the distance from the site boundary to the nearest highway. These accidents would have negligible consequence to the plant. The NRC staff concluded that these accidents do not contribute to the risk of core damage (NRC 2011g).

5.11.2.5 Summary of Severe Accident Impacts

The Duke application refers to proposed Revision 17 of the AP1000 reactor certified design (10 CFR Part 52, Appendix D). The consequence assessment is based on the PRA for

Revision 15 of the AP1000 design (Westinghouse 2005), which is certified in 10 CFR Part 52, Appendix D. Westinghouse subsequently upgraded and updated the PRA; however, Westinghouse reviewed the AP1000 PRA report submitted with Revision 15 of the DCD and concluded that the reported results and insights remain valid for proposed revisions of the DCD (Westinghouse 2010b). The NRC staff evaluated the current PRA model and its results using DC/COL-ISG-3 (NRC 2008g), *Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applic*ations, and concluded that the Revision 15 results remain conservative and are an acceptable basis for evaluating severe accidents and strategies for mitigating them. Duke is required by regulation to upgrade and update the PRA prior to fuel loading. At that time, the NRC staff expects the PRA to be site-specific and that it will no longer use the bounding assumptions of the design-specific PRA. The NRC staff considers it unlikely that the PRA would change sufficiently to cause the staff to materially change its conclusions related to severe accident risks.

The NRC staff reviewed the risk analysis in the ER and conducted a confirmatory analysis of the probability-weighted consequences of severe accidents for the proposed Lee Nuclear Station Units 1 and 2 using the MACCS2 code. The results of both the Duke analysis and the NRC evaluation indicate that the environmental risks associated with severe accidents if an AP1000 reactor were to be located at the Lee Nuclear Station site would be small compared with risks associated with operation of the current-generation reactors at other sites. These risks are below the NRC safety criteria. On these bases, the NRC staff concludes that the probability-weighted consequences of severe accidents at the Lee Nuclear Station site would be SMALL for an AP1000 reactor.

5.11.3 Severe Accident Mitigation Alternatives

The purpose of the evaluation of severe accident mitigation alternatives (SAMAs) is to determine whether there are severe accident mitigation design alternatives (SAMDAs), procedural modifications, or training activities that can be justified to further reduce the risks of severe accidents (NRC 2000b). Duke based its COL application on the AP1000 reactor design (see Appendix D of 10 CFR Part 52 – Design Certification Rule for the AP1000 Design), which incorporates many features intended to reduce severe accident CDFs and the risks associated with severe accidents. The effectiveness of the AP1000 reactor design features is evident in Table 5-14 and Table 5-15, which compare CDFs and severe accident risks for the AP1000 reactor with CDFs and risks for current-generation reactors. The CDFs and risks have generally been reduced considerably when compared to the existing current-generation reactors.

Consistent with the direction from the Commission to consider the SAMDAs at the time of certification, the AP1000 reactor vendor (Westinghouse 2005) and the NRC staff (NRC 2004b, 2005), considered a number of design alternatives for an AP1000 reactor at a generic site. The conclusion of the NRC staff's review was the following:

> "… none of the potential design modifications evaluated are justified on the basis of cost-benefit considerations. NRC further concludes that it is unlikely that any other design changes would be justified in the future on the basis of person-rem exposure because the estimated CDFs are very low on an absolute scale."

Westinghouse reviewed the AP1000 PRA for Revision 15 and concluded that the PRA remains valid for a proposed revision of the DCD (Westinghouse 2010b); this is unchanged for subsequent revisions through Revision 19 (Westinghouse 2011). Furthermore, the NRC staff evaluated the current PRA using DC/COL-ISG-3 (NRC 2008g), *Probabilistic Risk Assessment Information to Support Design Certification and Combined License Applications*, and concluded that the PRA submitted with Revision 15 is a conservative and acceptable basis for evaluating severe accidents and strategies for mitigating them. Therefore, the NRC considers the PRA for DCD Revision 15 to be an appropriate basis for a SAMDA analysis for an application referencing DCD Revision 19. Consequently, the NRC staff incorporates by reference the environmental assessment accompanying the design-certification rulemaking for Appendix D to 10 CFR Part 52 (NRC 2006a, b, c).

Section 5.11.2 presents the environmental risks from various classes of severe accidents for the Lee Nuclear Station site. Site-specific information appears in SAMDA evaluations as population dose risk (person-rem/Ryr) and offsite economic costs ($/Ryr). The NRC staff considers these two elements to be the appropriate metrics to use to determine whether the site characteristics are bounded by the site parameters because they are calculated from the site-specific meteorology, population distribution, and land-use data. Appendix 1B of the AP1000 DCD lists the population dose risk (person-rem/Ryr) used in the DCD generic SAMDA review. While it does not list the offsite economic costs, it does include a maximum attainable benefit that considers offsite economic costs, onsite exposure costs, onsite cleanup costs, and replacement power costs, in addition to the cost associated with the offsite population dose risk. To perform a like-kind comparison, the NRC staff used the maximum attainable benefit-cost for the Lee Nuclear Station site. The DCD probability-weighted, mean population dose risks from Table 1B-1 in Appendix 1B and the base-case maximum attainable benefit listed in Table 1B-4 are the metrics used by the NRC staff to determine whether the Lee Nuclear Station site characteristics are within the site parameters specified in Appendix 1B of the AP1000 DCD.

Table 5-17 presents the comparison of Lee Nuclear Station site-specific values (Duke 2009c) with the generic values from Appendix 1B of the AP1000 DCD (Westinghouse 2011). Table 5-17 shows that the population dose risk for the Lee Nuclear Station site is about 23 percent larger than the DCD Appendix 1B value, while the maximum attainable benefit for the Lee Nuclear Station site is only about 51 percent of the DCD Appendix 1B value. The NRC staff examined the sensitivity of the maximum attainable benefit at the Lee Nuclear Station site to a higher plant capacity factor in replacement power costs; the NRC staff concluded that although the maximum attainable benefit would be higher, it would still be less than the DCD Appendix 1B value.

Table 5-17. Comparison of the Lee Nuclear Station Site SAMDA Characteristics with Parameters Specified in Appendix 1B of the AP1000

	Population Dose Risk, person-rem/Ryr	Maximum Attainable Benefit
DCD Appendix 1B (internal events)	4.3×10^{-2}	$21,000
Lee Nuclear Station site (internal events)	5.3×10^{-2}	$10,700
Lee Nuclear Station site risk as fraction of DCD risk	123%	51%

The generic AP1000 SAMDA analysis is presented in Appendix 1B of the DCD (Westinghouse 2011). Design alternatives considered by Westinghouse and their estimated implementation costs are presented in Table 5-18 (Westinghouse 2011, Table 1B-5). In the base-case analysis, the benefit-cost methodology of NUREG/BR-0184 (NRC 1997) is used to calculate the maximum attainable benefit. The analysis assumes that the implementation of the design alternative completely eliminates all potential for core damage. For the AP1000, the maximum attainable benefit was valued at $21,000 (Westinghouse 2011, Appendix 1B, Section 1B.1.8). Only one design alternative identified in Table 5-18—the self-actuating containment isolation valves—has a cost ($33,000) comparable to the maximum attainable benefit. To evaluate the benefit of this SAMDA, the design change was assumed to eliminate the containment isolation severe accident release category, which is only a small contributor to the total CDF. Therefore, this design alternative provides almost no benefit in reducing the AP1000 CDF.

Table 5-18. Design Alternatives Considered for SAMDA in the AP1000 DCD

No.	Design Alternative	Cost ($)
1	Upgrade chemical, volume, and control system for small loss-of-coolant accident	1,500,000
2	Containment filtered vent	5,000,000
3	Self-actuating containment isolation valves	33,000
4	Safety grade passive containment spray	3,900,000
6	Steam generator shell-side heat removal	1,300,000
7	Steam generator relief flow to in-containment refueling water storage tank (IRWST)	620,000
8	Increased steam generator pressure capability	8,200,000
9	Secondary containment ventilation with filtration	2,200,000
10	Diverse IRWST injection valves	570,000
12	Ex-vessel core catcher	1,660,000
13	High-pressure containment design	50,000,000
14	More reliable diverse actuation system	470,000

Source: Westinghouse 2011, Table 1B-5

The Duke ER updates the SAMDA analysis conducted for AP1000 design certification using the results of the Lee Nuclear Station site-specific consequence analysis (MACCS2) discussed in Section 7.2 of the ER and Section 5.2 of this EIS. The results of the Duke analysis indicate that the maximum potential benefit if the total risk for the Lee Nuclear Station could be reduced to zero has a value of about $10,700. Similar to the finding in the AP1000 DCD SAMDA analysis, only the self-actuating containment isolation valves design alternative (Table 5-18) has a value comparable to the maximum attainable benefit for the Lee Nuclear Station site.

Table 5-14, which lists the mean environmental risks from an AP1000 reactor severe accident at the Lee Nuclear Station site, shows that the containment isolation severe accident category only contributes a small fraction to the total population dose and cost risk (approximately 3 percent each) at the Lee Nuclear Station site. Assuming that implementation of the self-actuating containment isolation valves completely eliminates the risks associated with this release category, then the value of the reduction in risk would only be approximately $321. Thus, the site-specific SAMDA review conducted by Duke confirms the results of the design-certification SAMDA review. Although the dose risk for the Lee Nuclear Station site exceeds the DCD value, the site-specific SAMDA analysis for the Lee Nuclear Station site shows that the resulting design alternative (self-actuating containment isolation valves) would only reduce this total risk by a small fraction. The next lowest cost design alternative has more than an order-of-magnitude higher cost than the self-actuating containment isolation valves. On this basis, the NRC staff concludes that, in fact, none of the potential design modifications are justified on the basis of benefit-cost considerations, and it is unlikely that any other design changes would be justified in the future on the basis of person-rem exposure because the estimated CDFs are very low on an absolute scale.

Duke is required by regulation to update the PRA prior to fuel loading. The NRC staff expects the PRA to be site-specific rather than use the bounding assumptions used for the design-specific PRA. The NRC staff considers it unlikely that the PRA would change sufficiently to cause the NRC staff to conclude that any SAMDA considered in the design certification process would become cost beneficial.

The SAMDA issue is a subset of the SAMA review. Duke has not yet addressed the other attributes of the SAMA review (i.e., procedural modifications and training activities). However, Duke has stated (Duke 2009c) that risk insights would be considered in the development of plant procedures and training. Because the maximum attainable benefit is so low, a SAMA based on procedures or training for an AP1000 reactor at the Lee Nuclear Station site would have to reduce the CDF or risk to near zero to become cost beneficial. Based on its evaluation, the NRC staff concludes that it is unlikely that any of the SAMAs based on procedures or training would reduce the CDF or risk that much. Therefore, the NRC staff further concludes it is unlikely that these SAMAs would be cost effective. In addition, based on statements by Duke in the ER (Duke 2009c), the NRC staff expects that Duke will consider risk insights in the development of procedures and training. However, this expectation is not crucial to the staff's conclusions because the staff already concluded procedural and training SAMAs would be unlikely to be cost effective. Therefore, the NRC staff concludes that SAMAs have been appropriately considered.

5.11.4 Summary of Postulated Accident Impacts

The NRC staff evaluated the environmental impacts from DBAs and severe accidents for an AP1000 reactor at the Lee Nuclear Station site. Based on the information provided by Duke and the NRC's own independent review, the NRC staff concludes that the potential environmental impacts (risks) from a postulated accident from the operation of the proposed Lee Nuclear Station Units 1 and 2 would be SMALL, and no further mitigation would be warranted.

5.12 Measures and Controls to Limit Adverse Impacts During Operation

In its evaluation of environmental impacts during operation of the proposed Lee Nuclear Station Units 1 and 2, the review team relied on Duke's compliance with the following measures and controls that would limit adverse environmental impacts:

- compliance with applicable Federal, State, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts (e.g., solid waste management, erosion and sediment control, air emissions, noise control, stormwater management, spill response and cleanup, hazardous material management)
- compliance with applicable requirements of permits or licenses required for operation of the new units (e.g., Department of the Army Section 404 Permit, NPDES)
- implementation of BMPs.

The review team considered these measures and controls in its evaluation of the impacts of plant operation. Table 5-19 lists a summary of measures and controls to limit adverse impacts during operation proposed by Duke.

Table 5-19. Summary of Measures and Controls Proposed by Duke to Limit Adverse Impacts During Operation of Proposed Lee Nuclear Station Units 1 and 2

Impact Category	Specific Measures and Control
Land-use impacts	
The site and vicinity, including Make-Up Pond C	Operations are not expected to result in land-use changes.
Transmission-line corridors and offsite areas	Duke did not propose any additional measures or controls.
Historic properties and cultural resources	Implement Duke's corporate procedures as outlined in the Lee Nuclear Station site cultural resources management plan and associated MOA to protect known historic and cultural resources and halt work and contact the South Carolina SHPO and THPO(s), as appropriate, if a potential historic property or cultural resource is unexpectedly discovered.
	Ensure continued avoidance of potential human burial site (38CK172) during maintenance of transmission lines.
Water-related impacts	
Hydrologic Alterations and Plant Water Supply	Makeup water is primarily supplied by the Broad River. Under low-flow conditions, supplemental water can be transferred from Make-Up Pond B to Make-Up Pond A, or from Make-Up Pond C to Make-Up Pond B to Make-Up Pond A.
	Operate proposed Lee Nuclear Station Units 1 and 2 within the minimum release constraints of Ninety-Nine Islands Hydroelectric Project License (FERC).
	Prepare and maintain a stormwater pollution prevention plan (SWPPP) and comply with NPDES permit to minimize releases.
	Install multiport diffuser pipe to maximize thermal and chemical dissolution.
	Install riprap, stemwalls, or other erosional control devices to stabilize the banks.
	Refill Make-Up Ponds B and C from the Broad River only during non-low-flow conditions.
	Significant drawdown events of Make-Up Pond C are rare.
	Infrequent use/refill minimizes sediment deposition.

Table 5-19. (contd)

Impact Category	Specific Measures and Control
Water-use impacts	Operate the proposed Lee Nuclear Station Units 1 and 2 within the minimum release constraints of Ninety-Nine Islands Hydroelectric Project License (FERC).
	Makeup water is supplied onsite from Make-Up Pond B and Make-Up Pond C when flow in the Broad River is less than 483 cfs.
	Dilute blowdown with receiving water.
	Limit planned effluent discharges in compliance with an NPDES permit.
Water-quality impacts	Proposed Lee Nuclear Station Spill Prevention, Control, and Countermeasure Plan
	Prepare and maintain an SWPPP and an NPDES permit to minimize releases.
	Install multiport diffuser to maximize thermal and chemical mixing.
	Limit planned effluent discharges in compliance with CWA regulations (40 CFR Parts 100 and 400-501), Federal Water Pollution Control Act, and NPDES permit specifications.
	Monitor water discharges.
Cooling-system impacts	
Intake system	
Hydrodynamic descriptions and physical impacts	Stabilize banks of the embayment and shoreline with concrete mats, riprap, or other appropriate means.
	Periodically dredge intake as required.
Aquatic ecosystems	Use closed-cycle technology and cooling towers, size and design intake structures to ensure water velocity across screens is less than 0.5 fps. Use return systems to deposit impinged fish and other aquatic biota downstream of the Broad River intake and outside the influence of the Make-Up Pond A intake, respectively.
	Supply makeup water from Make-Up Pond B and Make-Up Pond C during low-flow conditions.
	Minimize drawdown events and refill Make-Up Ponds as soon as practicable.
	Use BMPs to minimize sediment loading during maintenance dredging activities.

Table 5-19. (contd)

Impact Category	Specific Measures and Control
Terrestrial ecosystems	Maximum drawdown events are rare; most drawdown events are less than 1 ft.
	Drawdowns that could temporarily affect existing wetlands around Make-Up Pond B and wetlands that could develop around Make-Up Pond C are rarer than most drawdown events which are less than 1 ft.
Discharge system	
Aquatic ecosystems	Use and strategically position a multiport diffuser to mitigate thermal impacts.
	To the extent practicable, employ and position equipment to reduce erosion or sedimentation effects.
	Treat effluents according to NPDES permit specifications.
	Use reactors' cooling towers and a closed-loop cooling cycle to significantly reduce the thermal plume effects on aquatic organisms.
Cooling towers	
Terrestrial ecosystems	Use drift eliminators to minimize cooling-tower drift.
	Train employees in Duke corporate Avian Protection Plan.
	Document bird mortalities and injuries through the FWS and SCDNR Migratory Bird Depredation Permits (MB000257-0 and MD-19-10, respectively).
Radiological impacts of normal operation	
Radiation doses to members of the public	Calculated radiation doses to members of the public within NRC and EPA standards (10 CFR Part 20, Appendix I of 10 CFR Part 50, and 40 CFR Part 190).
	Implement radiological effluent and environmental monitoring programs.
Impacts on biota other than members of the public	Calculated doses for biota are well within NCRP and IAEA guidelines.
	Implement REMP.
Occupational radiation doses	Estimated occupation doses are within NRC standards (10 CFR Part 20).
	Implement program to maintain occupational doses ALARA (10 CFR Part 20).

Table 5-19. (contd)

Impact Category	Specific Measures and Control
Environmental impact of waste	
Nonradioactive waste system impacts	All emissions and discharges comply with SCDHEC regulations and applicable air- and water-quality standards.
	Treat sanitary waste at an offsite municipal sewage-treatment plant.
	Carefully monitor and transfer hazardous waste to approved transporters and disposers.
	Dispose of nonhazardous nonradioactive waste according to applicable local, State, and Federal regulations.
Mixed-waste impacts	Limit mixed-waste generation through source reduction, recycling, and treatment options.
	Manage mixed-waste inventory in accordance with applicable NRC and EPA regulations.
	Maintain inventory of mixed waste in a designated storage area and monitor it prior to offsite disposal.
Waste minimization	Develop a hazardous waste minimization plan to address hazardous waste management, equipment maintenance, recycling and reuse, segregation, treatment, work planning, waste tracking, and awareness training.
Terrestrial ecosystems	Design, construct, and operate wastewater-treatment basins to minimize use by avifauna.
	Employ avian exclusion devices at wastewater-treatment basins.
Transmission and water-pipeline corridor impacts	
Terrestrial ecosystems	Implement procedures that minimize adverse impacts to wildlife and important habitats such as floodplains and wetlands from transmission-line and water-pipeline corridor maintenance.
	Minimize potential impacts (e.g., erosion and sedimentation) through compliance with permitting requirements and BMPs.
	Minimize avian electrocutions and collisions on transmission lines by following Avian Power Line Interaction Committee guidelines (e.g., minimal separation distances between conductors, nest platforms, diverters).
	Train employees in Duke corporate Avian Protection Plan.

Table 5-19. (contd)

Impact Category	Specific Measures and Control
	Document bird mortalities and injuries and disturbances of active nests through the FWS and SCDNR Migratory Bird Depredation Permits (MB000257-0 and MD-19-10, respectively).
	As practicable, vehicles/machinery use noise suppression/mufflers and vehicles are maintained to reduce emissions.
	Make spill response materials and trained personnel readily available to respond to, clean up, and report spills.
	Train employees in hazardous materials/waste procedures to minimize the risk of spills.
	Use trained, licensed employees to apply herbicides.
Aquatic ecosystems	Minimize potential impacts through compliance with permitting requirements and BMPs.
	To the extent feasible, avoid any additional disturbances on sensitive aquatic habitats/species.
	As practicable, reseed cleared areas to limit erosion.
	Apply appropriate erosion controls (grassed or wooded buffer strips, board roads, and removable mats). Obtain a permit before dredge or fill activities.
	Apply herbicides using proper management practices and trained employees who possess an herbicide application permit.
	Train employees in hazardous materials/waste procedures to minimize risk of spills.
Impacts on members of the public	Build lines to specifications minimizing electrocution (high enough to comply with 5 mA standard away from existing buildings).
	Retain natural vegetation at road and river crossings during construction to help minimize ground-level visual impacts unless engineering requirements dictate otherwise.
	Avoid Important viewsheds.
	No towers along the new transmission lines are expected to exceed 200 ft in height, nor are there any airports, airstrips, or heliports within 20,000 ft of the transmission-line corridors currently under review by Duke.

Table 5-19. (contd)

Impact Category	Specific Measures and Control
Socioeconomic impacts	
Physical impacts of proposed units	Follow 1910.95, OSHA noise standard.
	Air emissions conform to SCDHEC permit limitations.
Social and economic impacts of proposed units	Increased property and worker-related taxes can help offset some of the problems related to increased population such as community facilities and infrastructure, police, fire protection, and schools.
	Refer to mitigations listed for Section 5.3.
	Based on vacancy data from the 2000 Census, sufficient housing units are available.
	Operate the Lee Nuclear Station within the minimum release constraints of the Ninety-Nine Islands Hydroelectric Project license (FERC).
	Comply with OSHA regulations for worker safety and health.
Environmental justice	No mitigation required beyond that listed above.

Source: Adapted from Table 5.10-1 of Duke 2009c

5.13 Summary of Operational Impacts

Impact level categories are denoted in Table 5-20 as SMALL, MODERATE, or LARGE as a measure of their expected adverse impacts, if any. When socioeconomic impacts are likely to be beneficially MODERATE or LARGE, it is noted both in the comments and impact level columns.

Table 5-20. Summary of Operational Impacts for the Proposed Lee Nuclear Station

Resource Category	Comments	Impact Level
Land Use		
The site and vicinity	In general, land uses onsite would not change during plant operations. Facility maintenance activities may require continued removal or disturbance of vegetation on portions of the site. Access to Make-Up Pond C will be restricted, and some temporary closures of part of Rolling Mill Road may occur during pipeline corridor maintenance.	SMALL
Transmission corridors and other offsite areas	Some temporary closures of part of Rolling Mill Road may occur during pipeline corridor maintenance. Land-use impacts related to corridor maintenance would be minimal.	SMALL
Water-Related		
Surface-water use	Consumptive water use by Units 1 and 2, through cooling-tower evaporation and drift, would be only a small proportion of Broad River flow.	SMALL
Groundwater use	There would be no use of groundwater during operation. There would be only local and short-term effects on groundwater from drawdown of the makeup ponds during low-river-flow events.	SMALL
Surface-water quality	Blowdown and other wastewater discharges represent a very small proportion of Broad River flow; all effluent discharges require an NPDES permit.	SMALL
Groundwater quality	There would be no use of groundwater and no discharges to groundwater during operation. The effects of Make-Up Pond C during fill events on water quality in nearby groundwater wells would be similar to existing groundwater quality in the region, temporary, and minor.	SMALL

Table 5-20. (contd)

Resource Category	Comments	Impact Level
Ecology		
Terrestrial and wetland ecosystems	Impacts on terrestrial and wetland resources from operation of two new nuclear units, including the cooling towers, makeup ponds, transmission lines, railroad spur, wastewater-treatment basins, nighttime security lighting, transmission and water-pipeline corridor maintenance, increased vehicle traffic, dredged material disposal, and EMFs would be minor.	SMALL
Aquatic ecosystems	Because of the use of low through-screen intake velocity, the use of closed-cycle cooling, the design of the Broad River intake structure flush with the shoreline, and the use of proven fish-friendly technologies, impacts on aquatic resources from operation of two new nuclear units would be minimal.	SMALL
Socioeconomics		
Physical impacts	Physical impacts of operation on workers and the local public, buildings, transportation, and aesthetics would be minimal.	SMALL
Demography	Operations workers would constitute a less than 1 percent increase over the baseline population of Cherokee and York Counties. Outage workers would be onsite for approximately 30 days every 18 months per unit.	SMALL (beneficial)
Economic impacts on the community	Tax base impacts would be SMALL except in Cherokee County where they would be LARGE and beneficial.	SMALL to LARGE (beneficial)
Infrastructure and community services	The operations workforce would be considerably smaller than the building peak employment and would have a minimal impact.	SMALL
Environmental Justice	There would be no disproportionately high and adverse impact on any minority or low-income populations in the region during operation of the Lee Nuclear Station.	SMALL

Table 5-20. (contd)

Resource Category	Comments	Impact Level
Historic and Cultural Resources	Operations impacts to historic and cultural resources would be negligible with implementation of Duke's corporate procedures and the Lee Nuclear Station site cultural resources management plan and associated MOA to protect known historic and cultural resources and address any unexpected discoveries of potential historic properties or cultural resources.	SMALL
Air Quality	Potential impacts from operation of proposed Lee Nuclear Station Units 1 and 2 on air quality from emissions of criteria pollutants, CO_2 emissions, cooling-system emissions, and transmission lines would be minimal.	SMALL
Nonradiological Health	Health risks to workers would be dominated by occupational injuries at rates below the average U.S. industrial rate. Health effects to the public and workers from thermophilic microorganisms, noise generated by unit operations, and acute impacts of EMFs would be minimal. The chronic effects of ELF-EMF on human health does not conclusively link ELF-EMF to adverse health impacts. Traffic accident impacts during operations would increase the rate of local traffic impacts marginally.	SMALL
Radiological Health		
Members of the public	Doses to members of the public would be below NRC and EPA standards and there would be no observable health impacts (10 CFR Part 20, Appendix I to 10 CFR Part 50, 40 CFR Part 190).	SMALL
Plant workers	Occupational doses to plant workers would be below NRC standards (10 CFR 20.1201) and a program to maintain doses ALARA would be implemented.	SMALL
Biota other than humans	Doses to biota other than humans would be well below NCRP and IAEA guidelines.	SMALL

Table 5-20. (contd)

Resource Category	Comments	Impact Level
Nonradioactive Waste	Based on the effective practices for recycling, minimizing, managing, and waste disposal planned to be used at the Lee Nuclear Station site, and the expectation that regulatory approvals will be obtained to regulate the additional waste that would be generated from proposed Units 1 and 2, potential impacts would be minimal.	SMALL
Postulated Accidents		
Design basis accidents	Impacts of DBAs would be well below regulatory limits.	SMALL
Severe accidents	The environmental risks of severe accidents are well below the NRC safety criteria.	SMALL

(a) The ICRP (ICRP 1977, 1991) states that if humans are adequately protected, other living things are also likely to be sufficiently protected.

6.0 Fuel Cycle, Transportation, and Decommissioning

This chapter addresses the environmental impacts from (1) the uranium fuel cycle and solid waste management, (2) the transportation of radioactive material, and (3) the decommissioning of proposed William States Lee III Nuclear Station (Lee Nuclear Station) Units 1 and 2. In its evaluation of uranium fuel-cycle impacts from proposed Units 1 and 2, Duke Energy Carolinas, LLC (Duke) used the Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water reactor design. While the capacity factor reported by Westinghouse (Westinghouse 2008) for the AP1000 reactor design is 95 percent, Duke assumed two units with a capacity factor of 93 percent (Duke 2009c).

6.1 Fuel-Cycle Impacts and Solid Waste Management

This section contains a discussion of the environmental impacts from the uranium fuel cycle and solid waste management for the AP1000 reactor design. The environmental impacts of this design are evaluated against specific criteria for light water reactor (LWR) designs in Title 10 of the *Code of Federal Regulations* (CFR) 51.51.

The regulations in 10 CFR 51.51(a) state the following:

> Under § 51.50, every environmental report prepared for the construction permit stage or early site permit stage or combined license stage of a light-water-cooled nuclear power reactor, and submitted on or after September 4, 1979, shall take Table S–3, Table of Uranium Fuel Cycle Environmental Data, as the basis for evaluating the contribution of the environmental effects of uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, reprocessing of irradiated fuel, transportation of radioactive materials and management of low-level wastes and high-level wastes related to uranium fuel cycle activities to the environmental costs of licensing the nuclear power reactor. Table S–3 shall be included in the environmental report and may be supplemented by a discussion of the environmental significance of the data set forth in the table as weighed in the analysis for the proposed facility.

The AP1000 reactors proposed for the Lee Nuclear Station would be LWRs that use uranium dioxide fuel; therefore, Table S–3 in 10 CFR 51.51(b) can be used to assess environmental impacts of the uranium fuel cycle. Table S–3 values are normalized for a reference 1000 megawatt electrical (MW[e]) LWR at an 80 percent capacity factor. The Table S–3 values are reproduced in Table 6-1.

Table 6-1. Table of Uranium Fuel Cycle Environmental Data[(a)]

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MW(e) LWR
Natural Resource Use		
Land (acres):		
Temporarily committed[(b)]	100	
Undisturbed area	79	
Disturbed area	22	Equivalent to a 100-MW(e) coal-fired power plant.
Permanently committed	13	
Overburden moved (millions of MT)	2.8	Equivalent to a 95-MW(e) coal-fired power plant.
Water (millions of gallons):		
Discharged to air	160	= 2 percent of model 1000-MW(e) LWR with cooling tower.
Discharged to water bodies	11,090	
Discharged to ground	127	
Total	11,377	<4 percent of model 1000 MW(e) with once-through cooling.
Fossil fuel:		
Electrical energy (thousands of MW-hr)	323	<5 percent of model 1000 MW(e) LWR output.
Equivalent coal (thousands of MT)	118	Equivalent to the consumption of a 45-MW(e) coal-fired power plant.
Natural gas (millions of standard cubic feet)	135	<0.4 percent of model 1000 MW(e) energy output.
Effluents--Chemical (MT)		
Gases (including entrainment):[(c)]		
SO_x^{-1}	4400	
NO_x^{-1}[(d)]	1190	Equivalent to emissions from 45 MW(e) coal-fired plant for a year.
Hydrocarbons	14	
CO	29.6	
Particulates	1154	
Other gases:		
F	0.67	Principally from uranium hexafluoride (UF_6) production, enrichment, and reprocessing. The concentration is within the range of State standards–below the level that affects human health.
HCl	0.014	

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MW(e) LWR
Liquids:		
SO_4^-	9.9	From enrichment, fuel fabrication, and reprocessing steps. Components that constitute a potential for adverse environmental effect are present in dilute concentrations and receive additional dilution by receiving bodies of water to levels below permissible standards. The constituents that require dilution and the flow of dilution water are: NH_3—600 cfs, NO_3—20 cfs, fluoride—70 cfs.
NO_3^-	25.8	
Fluoride	12.9	
Ca^{++}	5.4	
Cl^-	8.5	
Na^+	12.1	
NH_3	10	
Fe	0.4	
Tailings solutions (thousands of MT)	240	From mills only–no significant effluents to environment.
Solids	91,000	Principally from mills–no significant effluents to environment.
Effluents–Radiological (curies)		
Gases (including entrainment):		
Rn-222		Presently under reconsideration by the Commission.
Ra-226	0.02	
Th-230	0.02	
Uranium	0.034	
Tritium (thousands)	18.1	
C-14	24	
Kr-85 (thousands)	400	
Ru-106	0.14	Principally from fuel reprocessing plants.
I-129	1.3	
I-131	0.83	
Tc-99		Presently under consideration by the Commission.
Fission products and transuranics	0.203	
Liquids:		
Uranium and daughters	2.1	Principally from milling–included tailings liquor and returned to ground–no effluents; therefore, no effect on environment.
Ra-226	0.0034	From UF_6 production.
Th-230	0.0015	

Table 6-1. (contd)

Environmental Considerations	Total	Maximum Effect per Annual Fuel Requirement or Reference Reactor Year of Model 1000 MW(e) LWR
Th-234	0.01	From fuel fabrication plants–concentration 10 percent of 10 CFR Part 20 for total processing 26 annual fuel requirements for model LWR.
Fission and activation products	5.9×10^{-6}	
Solids (buried onsite):		
Other than high level (shallow)	11,300	9100 Ci comes from low-level reactor wastes and 1500 Ci comes from reactor decontamination and decommissioning—buried at land burial facilities. 600 Ci comes from mills—included in tailings returned to ground. Approximately 60 Ci comes from conversion and spent fuel storage. No significant effluent to the environment.
TRU and HLW (deep)	1.1×10^{7}	Buried at Federal repository.
Effluents—thermal (billions of British thermal units)	4063	<5 percent of model 1000-MW(e) LWR.
Transportation (person-rem):		
Exposure of workers and general public	2.5	
Occupational exposure (person-rem)	22.6	From reprocessing and waste management.

Source: 10 CFR 51.51, Table S-3.

(a) In some cases where no entry appears, it is clear from the background documents that the matter was addressed and that, in effect, the table should be read as if a specific zero entry had been made. However, other areas are not addressed at all in the table. Table S–3 does not include health effects from the effluents described in the table, estimates of releases of radon-222 from the uranium fuel cycle, or estimates of technetium-99 released from waste-management or reprocessing activities. These issues may be the subject of litigation in the individual licensing proceedings.
Data supporting this table are given in the *Environmental Survey of the Uranium Fuel Cycle* (WASH-1248, AEC 1974); *Environmental Survey of the Reprocessing and Waste Management Portion of the LWR Fuel Cycle* (NUREG-0116, Supp.1 to WASH-1248) (NRC 1976b); *Public Comments and Task Force Responses Regarding the Environmental Survey of the Reprocessing and Waste Management Portions of the LWR Fuel Cycle* (NUREG-0216, Supp. 2 to WASH-1248) (NRC 1977c); and in the record of the final rulemaking pertaining to *Uranium Fuel Cycle Impacts from Spent Fuel Reprocessing and Radioactive Waste Management*, Docket RM-50-3 (NRC 1978). The contributions from reprocessing, waste management, and transportation of wastes are maximized for both fuel cycles (uranium only and no-recycle). The contribution from transportation excludes transportation of cold fuel to a reactor and of irradiated fuel and radioactive wastes from a reactor, which are considered in Table S–4 of Sec. 51.20(g). The contributions from the other steps of the fuel cycle are in columns A-E of Table S-3A in WASH-1248.

(b) Contributions to temporarily committed land from reprocessing are not prorated over 30 years because the complete temporary impact accrues whether the plant services 1 reactor for 1 year or 57 reactors for 30 years.

(c) Estimated effluents based upon combustion of equivalent coal for power generation.

(d) 1.2% from natural gas use and process.

Specific categories of environmental considerations are included in Table S–3 (see Table 6-1). These categories relate to land use, water consumption and thermal effluents, radioactive releases, burial of transuranic and low-level waste (LLW) and high-level waste (HLW), and radiation doses from transportation and occupational exposures. In developing Table S–3, U.S. Nuclear Regulatory Commission (NRC) staff considered two fuel-cycle options that differed in the treatment of spent fuel removed from a reactor. The “no-recycle” option treats all spent fuel as waste to be stored at a Federal waste repository, while the “uranium-only recycle” option involves reprocessing spent fuel to recover unused uranium and return it to the system. Neither cycle involves the recovery of plutonium. The contributions in Table S–3 resulting from reprocessing, waste management, and transportation of wastes are maximized for both of the fuel cycles (uranium only and no-recycle); that is, the identified environmental impacts are based on the cycle that results in the greater impact. The uranium fuel cycle is defined as the total of those operations and processes associated with provision, utilization, and ultimate disposition of fuel for nuclear power reactors.

The Nuclear Non-Proliferation Act of 1978 (22 U.S.C. 3201 et seq.) significantly affected the disposition of spent nuclear fuel by deferring indefinitely the commercial reprocessing and recycling of spent fuel produced in the U.S. commercial nuclear power program. While the ban on the reprocessing of spent fuel was lifted during the Reagan administration, economic circumstances changed, reserves of uranium ore increased, and the stagnation of the nuclear power industry provided little incentive for industry to resume reprocessing. During the 109th Congress, the Energy Policy Act of 2005 (42 U.S.C. 15801) was enacted. It authorized the U.S. Department of Energy (DOE) to conduct an advanced fuel-recycling technology research and development program to evaluate proliferation-resistant fuel-recycling and transmutation technologies that minimize environmental or public health and safety impacts. Consequently, while Federal policy does not prohibit reprocessing, additional DOE efforts would be required before commercial reprocessing and recycling of spent fuel produced in the U.S. commercial nuclear power plants could begin.

The no-recycle option is presented schematically in Figure 6-1. Natural uranium is mined in open-pit or underground mines or by an *in situ* leach solution mining process. *In situ* leach mining, presently the primary form of mining in the United States, involves injecting a lixiviant solution into the uranium ore body to dissolve uranium and then pumping the solution to the surface for further processing. The ore or *in situ* leach solution is transferred to mills where it is processed to produce “yellowcake” (U_3O_8). A conversion facility prepares the U_3O_8 by converting it to uranium hexafluoride (UF_6), which is then processed by an enrichment facility to increase the percentage of the more fissile isotope uranium-235 and decrease the percentage of the non-fissile isotope uranium-238. At a fuel fabrication facility, the enriched uranium, which is approximately 5 percent uranium-235, is then converted to uranium dioxide (UO_2). The UO_2 is pelletized, sintered, and inserted into tubes to form fuel assemblies, which are placed in a reactor to produce power. When the content of the uranium-235 reaches a point where the nuclear reactor has become inefficient with respect to neutron economy, the fuel assemblies are withdrawn from the reactor as spent fuel. After being stored onsite for sufficient time to allow for short-lived fission product decay and to reduce the heat generation rate, the fuel assemblies would be transferred to a waste repository for internment. Disposal of spent fuel elements in a repository constitutes the final step in the no-recycle option.

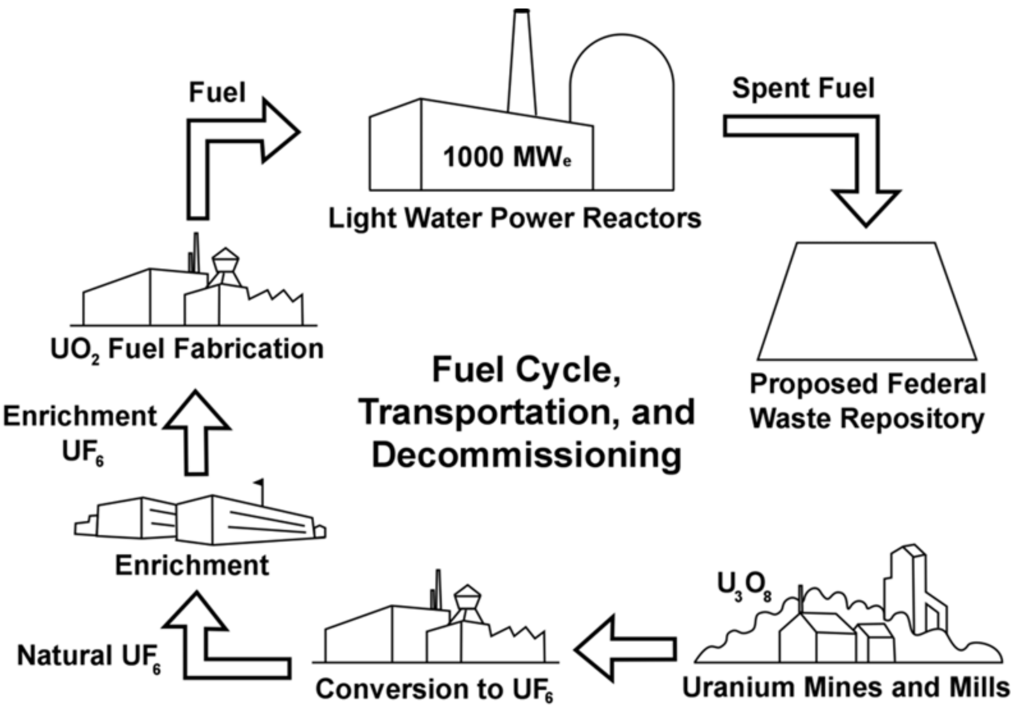

Figure 6-1. The Uranium Fuel Cycle No-Recycle Option (derived from NRC 1999a)

The following assessment of the environmental impacts of the fuel cycle as related to the operation of the proposed project is based on the values given in Table S–3 (Table 6-1) and the NRC staff's analysis of the radiological impact from radon-222 and technetium-99. In *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS) (NRC 1996, 1999a, 2013a)[(a)], the NRC staff provides a detailed analysis of the environmental impacts from the uranium fuel cycle. Although the GEIS is specific to the impacts related to license renewal, the information is relevant to this review because the advanced LWR design considered here uses the same type of fuel. The NRC staff's analyses in Section of the GEIS are summarized and set forth here.

(a) The GEIS for license renewal (NUREG-1437) was originally issued in 1996. Addendum 1 was issued in 1999. NUREG-1437, Revision 1, was issued in June 2013. The version cited, whether 1996 or 2013, is the version where the relevant technical information is discussed. Revision 1 is cited in cases where the relevant technical information is discussed in both documents.

Each AP1000 reactor unit is rated at 3400 MW(t) (Westinghouse 2008). Assuming that two AP1000 reactors would be located on the Lee Nuclear Station site (Duke 2009c), the power rating for the new units would be 6800 MW(t). Each AP1000 reactor unit is rated at greater than 1000 MW(e) (Westinghouse 2011). Duke conservatively assumes that total electrical output will be 15 percent greater than that, or 1150 MW(e), and then applies a capacity factor of 93 percent (Duke 2009c). Thus, each AP1000 unit is assumed to produce an average of 1070 MW(e). For two AP1000 units, this corresponds to 2140 MW(e).

The fuel-cycle impacts in Table S–3 are based on a reference 1000-MW(e) LWR operating at an annual capacity factor of 80 percent for a net electric output of 800 MW(e). As explained above, the NRC staff considered the capacity factor of 93 percent with a total net electric output of 2140 MW(e) for the proposed two new units at the Lee Nuclear Station (Duke 2009c); this is about 2.68 times (i.e., 2140 MW(e) divided by 800 MW(e) yields 2.68) the output value in Table S–3 (see Table 6-1). For added conservatism in its review and evaluation of the environmental impacts of the nuclear fuel cycle, the NRC staff multiplied the values in Table S–3 by a factor of 3, rather than a factor of 2.68, scaling the impacts upward to account for the increased electric generation of the two proposed AP1000 units. Scaling up by a factor of 3 is referred to as using the 1000-MW(e) LWR-scaled model.

Recent changes in the fuel cycle may have some bearing on environmental impacts; however, as discussed below, the NRC staff is confident that the contemporary fuel-cycle impacts are below those identified in Table 6-1. This is especially true in light of the following recent fuel-cycle trends in the United States:

- Increasing use of *in situ* leach uranium mining, which does not produce mine tailings.
- Transitioning of U.S. uranium enrichment technology from gaseous diffusion to gas centrifuge. The centrifuge process uses only a small fraction of the electrical energy per separation unit compared to gaseous diffusion. (U.S. gaseous diffusion plants relied on electricity derived mainly from the burning of coal.)
- Current LWRs use nuclear fuel more efficiently due to higher fuel burnup. Therefore, less uranium fuel per year of reactor operation is required than in the past to generate the same amount of electricity.
- Fewer spent fuel assemblies per reactor-year are discharged, hence the waste storage/repository impact is lessened.

The values in Table S–3 were calculated from industry averages for each type of facility or operation within the fuel cycle. Recognizing that this approach meant that there would be a range of reasonable values for each estimate, the NRC staff followed the policy of choosing the assumptions or factors to be applied so that the calculated values would not be underestimated. This approach was intended to ensure the actual environmental impacts would be less than the quantities shown in Table S–3 for all LWR nuclear power plants within the widest range of operating conditions. The NRC staff recognizes that many of the fuel-cycle parameters and interactions vary in small ways from the estimates in Table S–3; the NRC staff concludes that these variations would have no impacts on the Table S–3 calculations. For example, to determine the quantity of fuel required for a year's operation of a nuclear power plant in Table S–3 the NRC staff defined the model reactor as a 1000-MW(e) LWR reactor operating at 80 percent capacity with a 12-month fuel reloading cycle and an average fuel burnup of 33,000 MWd/MTU. This is a "reference reactor year" (Table S–3 or GEIS, Revision 1 (NRC 2013a)).

If approved, the combined licenses (COLs) for proposed Lee Nuclear Station Units 1 and 2 would allow 40 years of operation. The sum of the initial fuel loading plus all of the reloads for the lifetime of the reactor can be divided by the 60-year lifetime (40-year initial license term and 20-year license renewal term) to obtain an average annual fuel requirement. This approach was followed in the original GEIS (NRC 1996) and carried forward into Revision 1 (NRC 2013a) for both boiling water reactors and pressurized water reactors; the higher annual requirement, 35 MT of uranium made into fuel for a boiling water reactor, was chosen in the GEIS, Revision 1, as the basis for the reference reactor year (NRC 2013a). The average annual fuel requirement presented in the GEIS, Revision 1, would only be increased by 2 percent if a 40-year lifetime was evaluated. However, a number of fuel-management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative-work (enrichment) requirements. Since the time when Table S–3 was promulgated, these improvements have reduced the annual fuel requirement, which means the Table S–3 assumptions remain bounding as applied to the proposed two units.

Another change supporting the bounding nature of the Table S–3 assumptions with respect to impacts is the elimination of the U.S. restrictions on the importation of foreign uranium. Until recently, the economic conditions of the uranium market favored using foreign uranium at the expense of the domestic uranium industry. From the mid-1980s to 2004, the price of U_3O_8 remained below $20/lb. These market conditions forced the closing of most U.S. uranium mines and mills, substantially reducing the environmental impacts in the United States from uranium-mining activities. However, the spot price of uranium has increased dramatically from $24/lb in April 2005 to $135/lb in July 2007 and has decreased to near $41/lb as of November 2012 (UxC 2012). As a result, there is a renewed interest in uranium mining and milling in the United States and the NRC anticipates receiving multiple license applications for uranium mining and milling in the next several years (NRC 2013a). The majority of these applications are expected to be for *in situ* leach solution mining, which does not produce tailings. Factoring in changes to the fuel cycle suggests that the environmental impacts of mining and tail millings could drop to levels below those given in Table S–3; however, Table S–3 estimates remain bounding as applied to the proposed two units.

In summation, these reasons highlight why Table S–3 is likely to overestimate impacts from the proposed units and, therefore, remains a bounding approach for this analysis.

The preceding information shows that Table S–3 likely overestimates the impacts of the proposed units and, therefore, its use remains a bounding approach for this analysis. Section 4.12.1.1 of the GEIS, Revision 1 (NRC 2013a) and Section 6.2 of the GEIS (NRC 1996) discuss in greater detail the sensitivity to changes in the fuel cycle since issuance of Table S–3 on the environmental impacts.

6.1.1 Land Use

The total annual land requirement for the fuel cycle supporting the 1000-MW(e) LWR-scaled model is about 339 ac. Approximately 39 ac are permanently committed land, and 300 ac are temporarily committed. A "temporary" land commitment is a commitment for the life of the specific fuel cycle plant (e.g., a mill, enrichment plant, or succeeding plants). Following completion of decommissioning, such land can be released for unrestricted use. "Permanent" commitments represent land that may not be released for use after plant shutdown and decommissioning because decommissioning activities do not result in removal of sufficient radioactive material to meet the limits in 10 CFR Part 20, Subpart E, for release of that area for unrestricted use. Of the approximately 300 ac of temporarily committed land, about 237 ac are undisturbed and about 66 ac are disturbed. In comparison, a coal-fired power plant using the same MW(e) output as the LWR-scaled model and using strip-mined coal requires the disturbance of about 528 ac per year for fuel alone. The NRC staff concludes that the impacts on land use to support the 1000-MW(e) LWR-scaled model would be SMALL.

6.1.2 Water Use

The principal water use for the fuel cycle supporting a 1000-MW(e) LWR-scaled model is that required to remove waste heat from the power stations supplying electrical energy to the enrichment step of this cycle. Scaling from Table S-3, of the total annual water use of 3.41×10^{10} gal, about 3.33×10^{10} gal are required for the removal of waste heat, assuming that a new unit uses once-through cooling. Also, scaling from Table 6-1, other water uses involve the discharge to air (e.g., evaporation losses in process cooling) of about 4.80×10^{8} gal/yr and water discharged to the ground (e.g., mine drainage) of about 3.81×10^{8} gal/yr.

On a thermal-effluent basis, annual discharges from the nuclear fuel cycle are about 4 percent of the 1000-MW(e) LWR-scaled model using once-through cooling. The consumptive water use is about 2 percent of the 1000-MW(e) LWR-scaled model using cooling towers. The maximum consumptive water use (assuming that all plants supplying electrical energy to the nuclear fuel cycle use cooling towers) would be about 6 percent of the 1000-MW(e) LWR-scaled model using cooling towers. Under this condition, thermal effluents would be negligible. The NRC staff concludes that the impacts on water use for these combinations of thermal loadings and water consumption would be SMALL.

6.1.3 Fossil Fuel Impacts

Electric energy and process heat are required during various phases of the fuel-cycle process. The electric energy is usually produced by the combustion of fossil fuel at conventional power plants. Electric energy associated with the fuel cycle represents about 5 percent of the annual electric power production of the reference 1000-MW(e) LWR. Process heat is primarily generated by the combustion of natural gas. This gas consumption, if used to generate electricity, would be less than 0.4 percent of the electrical output from the model plant. The NRC staff concludes that the fossil fuel impacts from the direct and indirect consumption of electric energy for fuel-cycle operations would be SMALL relative to the net power production of the proposed project.

The largest use of electricity in the fuel cycle comes from the enrichment process. It appears that gas centrifuge (GC) technology is likely to eventually replace gaseous diffusion (GD) technology for uranium enrichment in the United States. The same amount of enrichment from a GC facility uses less electricity and, therefore, results in lower amounts of air emissions such as carbon dioxide (CO_2) than a GD facility. Therefore, the NRC staff concludes that the values for electricity use and air emissions in Table S–3 continue to be appropriately bounding values.

As indicated in Appendix J, the largest source of CO_2 emissions associated with nuclear power is from the fuel cycle, not operation of the plant. The largest source of CO_2 in the fuel cycle is production of electric energy from combustion of fossil fuel in conventional power plants. This energy is used to power components of the fuel cycle such as the enrichment process. The NRC staff compared emissions from a 45 MW(e) coal-fired power plant in Table 6-1 to the nuclear fuel cycle, and accounted for differences in generating capacity between a nuclear power plant and coal-fired power plant. The CO_2 emissions from the fuel cycle are about 5 percent of the CO_2 emissions from an equivalent coal-fired power plant.

In Appendix J, the NRC staff estimates that the carbon footprint of the fuel cycle to support a reference 1000-MW(e) LWR for a 40-year plant life is on the order of 17,000,000 MT of CO_2, including a very small contribution from other greenhouse gases. Scaling this footprint to the power level of the two proposed AP1000 reactor units using the scaling factor of 3 discussed earlier, the NRC staff estimates the carbon footprint for 40 years of fuel-cycle emissions to be approximately 51,000,000 MT (an emissions rate of about 1,300,000 MT annually, averaged over the period of operation) of CO_2, as compared to a total U.S. annual emissions rate of 5,500,000,000 MT (EPA 2011c).

On this basis, the NRC staff concludes that the fossil fuel impacts, including greenhouse gas emissions from the direct and indirect consumption of electric energy for fuel-cycle operations, would be SMALL.

6.1.4 Chemical Effluents

The quantities of chemical, gaseous, and particulate effluents with fuel-cycle processes are given in Table S-3 for the reference 1000-MW(e) LWR and, according to WASH-1248 (AEC 1974), result from the generation of electricity for fuel-cycle operations. The principal effluents are sulfur oxides, nitrogen oxides, and particulates. Table 6-1 states that the fuel cycle for the reference 1000-MW(e) LWR requires 323,000 MWh of electricity. The fuel cycle for the 1000-MW(e) LWR-scaled model would therefore require 969,000 MWh of electricity, or less than 0.024 percent of the 4.1 billion MWh of electricity generated in the United States in 2008 (DOE/EIA 2009a). Therefore, the gaseous and particulate chemical effluents from fuel-cycle processes to support the operation of the 1000-MW(e) LWR-scaled model would add less than 0.024 percent to the national gaseous and particulate chemical effluents for electricity generation.

Liquid chemical effluents produced in fuel-cycle processes are related to fuel enrichment and fabrication and may be released to receiving waters. These effluents are usually present in dilute concentrations such that only small amounts of dilution water are required to reach levels of concentration that are within established standards. Table 6-1 specifies the amount of dilution water required for specific constituents. Additionally, all liquid discharges into the navigable waters of the United States from plants associated with the fuel-cycle operations would be subject to requirements and limitations set by appropriate Federal, State, Tribal, and local agencies.

Tailings solutions and solids are generated during the milling process and, as indicated in Table 6-1, are not released in large enough quantities to have a significant impact on the environment.

Based on the above analysis, the NRC staff concludes that the impacts of these chemical effluents would be SMALL.

6.1.5 Radiological Effluents

Radioactive effluents estimated to be released to the environment from waste-management activities and certain other phases of the fuel-cycle process are listed in Table S–3. The GEIS (NRC 2013a) provides the 100-year environmental dose commitment to the U.S. population from the fuel cycle of 1 year of operation of the model 1000-MW(e) LWR using the radioactive effluents in Table 6-1. Excluding reactor releases and dose commitments because of exposure to radon-222 and technetium-99, the total overall whole body gaseous dose commitment and whole body liquid dose commitment from the fuel cycle were calculated to be approximately 400 and 200 person-rem, respectively. Scaling these dose commitments by a factor of about 3 for the 1000-MW(e) LWR-scaled model results in whole body dose commitment estimates of 1200 person-rem for gaseous releases and 600 person-rem for liquid releases. For both pathways, the estimated 100-year environmental dose commitment to the U.S. population would be approximately 1800 person-rem for the 1000-MW(e) LWR-scaled model.

Currently, the radiological impacts associated with radon-222 and technetium-99 releases are not addressed in Table S–3. Principal radon releases occur during mining and milling operations and as emissions from mill tailings, whereas principal technetium-99 releases occur from GD enrichment facilities. Duke provided an assessment of radon-222 and technetium-99 (Duke 2010l). This evaluation relied on the information discussed in the 1996 version of the GEIS (NRC 1996); NRC staff adapted the Duke assessment with the multiplier of 3, rather than Duke's multiplier of 2.675, as discussed in Section 6.1.

In Section 6.2 of the 1996 version of the GEIS (NRC 1996), the NRC staff estimated the radon-222 releases from mining and milling operations and from mill tailings for each year of operations of the reference 1000-MW(e) LWR. The estimated releases of radon-222 for the reference reactor year for the 1000-MW(e) LWR-scaled model, or for the total electric power rating for the site for a year, are approximately 15,600 Ci. Of this total, about 78 percent would be from mining, 15 percent from milling operations, and 7 percent from inactive tails before stabilization. For radon releases from stabilized tailings, the NRC staff assumed that the LWR-scaled model would result in an emission of 3 Ci per site year (i.e., about three times the estimate in the 1996 version of the GEIS [NRC 1996] for the reference reactor year). The major risks from radon-222 are from exposure to the bone and the lung, although there is a small risk from exposure to the whole body. The organ-specific dose-weighting factors from 10 CFR Part 20 were applied to the bone and lung doses to estimate the 100-year dose commitment from radon-222 to the whole body. The estimated 100-year environmental dose commitment from mining, milling, and tailings before stabilization for each site year (assuming the 1000-MW(e) LWR-scaled model) would be approximately 2800 person-rem to the whole body. From stabilized tailings piles, the estimated 100-year environmental dose commitment would be approximately 54 person-rem to the whole body. Additional insights regarding Federal policy/resource perspectives concerning institutional controls comparisons with routine radon-222 exposure and risk and long-term releases from stabilized tailing piles are discussed in the 1996 version of the GEIS (NRC 1996).

The NRC staff also considered the potential health effects associated with the releases of technetium-99 (NRC 2013a). The estimated releases of technetium-99 for the reference reactor year for the 1000-MW(e) LWR-scaled model are 0.02 Ci from chemical processing of recycled UF_6 before it enters the isotope enrichment cascade and 0.015 Ci into the groundwater from a repository. The major risks from technetium-99 are from exposure of the gastrointestinal tract and kidney, although there is a small risk from exposure to the whole body. Applying the organ-specific dose-weighting factors from 10 CFR Part 20 to the gastrointestinal tract and kidney doses, the total-body 100-year dose commitment from technetium-99 to the whole body was estimated to be 300 person-rem for the 1000-MW(e) LWR-scaled model.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A report by the National Research Council (2006), the Biological Effects of Ionizing Radiation (BEIR) VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv), equal to 0.00057 effect per person-rem. The coefficient is taken from Publication 103 of the International Commission on Radiological Protection (ICRP 2007).

The nominal probability coefficient was multiplied by the sum of the estimated whole body population doses from gaseous effluents, liquid effluents, radon-222, and technetium-99 discussed above (approximately 5000 person-rem/yr) to calculate that the U.S. population would incur a total of approximately 2.8 fatal cancers, nonfatal cancers, and severe hereditary effects annually.

Radon releases from tailings are indistinguishable from background radiation levels at a few kilometers from the tailings pile (at less than 0.6 mi in some cases) (NRC 1996). The public dose limit in the U.S. Environmental Protection Agency's (EPA's) regulation, 40 CFR Part 190, is 25 mrem/yr to the whole body from the entire fuel cycle, but most NRC licensees have airborne effluents resulting in doses of less than 1 mrem/yr (61 FR 65120).

In addition, at the request of Congress, the National Cancer Institute conducted a study and published *Cancer in Populations Living Near Nuclear Facilities* in 1990 (Jablon et al. 1990). This report included an evaluation of health statistics around all nuclear power plants, as well as several other nuclear fuel-cycle facilities, in operation in the United States in 1981 and found "no evidence that an excess occurrence of cancer has resulted from living near nuclear facilities" (Jablon et al. 1990). The contribution to the annual average dose received by an individual from fuel-cycle-related radiation and other sources as reported in a publication of the National Council on Radiation Protection and Measurements (NCRP 2009) is listed in Table 6-2. The nuclear fuel-cycle contribution to an individual's annual average radiation dose is extremely small (less than 0.1 mrem/yr) compared to the annual average background radiation dose (about 311 mrem/yr).

Based on the analyses presented above, the NRC staff concludes that the environmental impacts of radioactive effluents from the fuel cycle are SMALL.

Table 6-2. Comparison of Annual Average Dose Received by an Individual from All Sources

	Source	Dose (mrem/yr)[(a)]	Percent of Total
Ubiquitous background	Radon and thoron	228	37
	Space	33	5
	Terrestrial	21	3
	Internal (body)	29	5
	Total background sources	**311**	**50**
Medical	Computed tomography	147	24
	Medical x-ray	76	12
	Nuclear medicine	77	12
	Total medical sources	**300**	**48**
Consumer	Construction materials, smoking, air travel, mining, agriculture, fossil fuel combustion	13	2
Other	Occupational	0.5[(b)]	0.1
	Nuclear fuel cycle	0.05[(c)]	0.01
Total		**624**	**100**

Source: NCRP 2009.
(a) NCRP Report 160 table expressed doses in mSv/yr (1 mSv/yr equals 100 mrem/yr).
(b) Occupational dose is regulated separately from public dose and is provided here for informational purposes.
(c) Estimated using 153 person-Sv/yr from Table 6.1 of NCRP 160 and a 2006 U.S. population of 300 million.

6.1.6 Radiological Wastes

The estimated quantities of buried radioactive waste material (LLW, HLW, and transuranic waste) generated by the reference 1000-MW(e) LWR are specified in Table S–3. For LLW disposal at land burial facilities, the Commission notes that there would be no significant radioactive releases to the environment; such wastes generated by the Lee Nuclear Station would be shipped to the Energy Solutions disposal facility in Barnwell, South Carolina, or a similar replacement facility, because the proposed nuclear power station is within the Atlantic Compact. Class A LLW generated by the Lee Nuclear Station could also be shipped to the Energy Solutions disposal facility near Clive, Utah, as some Class A LLW generators within the state of South Carolina have done (DOE 2013).

The Barnwell facility is expected to be closed to LLW in 2038, including LLW generated in South Carolina (Chem-Nuclear Systems 2010). At that time, Duke could enter into an agreement with another licensed facility that would accept LLW from Lee Nuclear Station Units 1 and 2. Alternatively, Duke could implement measures to reduce the generation of Class B and C wastes, extending the capacity of the onsite solid waste storage system. Duke could also construct additional temporary storage facilities onsite. Finally, Duke could enter into an agreement with a third-party contractor to process, store, own, and ultimately dispose of LLW from Lee Nuclear Station Units 1 and 2. The Waste Control Specialists, LLC, site in Andrews County, Texas, is licensed to accept Class A, B, and C LLW from the Texas Compact

(Texas and Vermont). Waste Control Specialists, LLC, may accept Class A, B, and C LLW from outside the Texas Compact for disposal subject to established criteria, conditions, and approval processes (31 TAC Chapter 675.23). Because Duke would likely have to choose one or a combination of these options, the NRC staff considered the environmental impacts of each of these options.

Table S–3 addresses the environmental impacts if Duke enters into an agreement with a licensed facility for disposal of LLW, and Table S–4 addresses the environmental impacts from transportation of LLW as discussed in Section 6.2. The use of third-party contractors was not explicitly addressed in Tables S–3 and S–4; however, such third-party contractors are already licensed by the NRC or Agreement States and currently operate in the United States. Experience from the operation of these facilities shows that the additional environmental impacts are not significant compared to the impacts described in Tables S–3 and S–4.

Measures to reduce the generation of Class B and C wastes, such as reducing the service run length of resin beds, could increase the volume of LLW, but would not increase the total activity (in curies) of radioactive material in the waste. The volume of waste would still be bounded by, or very similar to, the estimates in Table S–3, and the environmental impacts would not be significantly different.

In most circumstances, the NRC's regulations (10 CFR 50.59) allow licensees operating nuclear power plants to construct and operate additional onsite LLW storage facilities without seeking approval from the NRC. Licensees are required to evaluate the safety and environmental impacts before constructing the facility and make those evaluations available to the NRC inspectors. A number of nuclear power plant licensees have constructed and operate such facilities in the United States. Typically, these additional facilities are constructed near the power block inside the security fence on land that has already been disturbed during initial plant construction. Therefore, the impacts on environmental resources (e.g., land use and aquatic and terrestrial biota) would be very small. All of the NRC (10 CFR Part 20) and EPA (40 CFR Part 190) dose limitations would apply both for public and occupational radiation exposure. The radiological environmental monitoring programs around nuclear power plants that operate such facilities show that the increase in radiation dose at the site boundary is not significant; the radiation doses continue to be below 25 mrem/yr, the dose limit of 40 CFR Part 190. The NRC staff concludes that doses to members of the public within the NRC and EPA regulations are a small impact. Therefore, the impacts from radiation would be SMALL.

In addition, the NRC staff assessed the impacts of onsite LLW storage at currently operating nuclear power plants and concluded that the radiation doses to offsite individuals from interim LLW storage are insignificant (NRC 2013a). The types and amounts of LLW generated by the proposed reactors at Lee Nuclear Station Units 1 and 2 would be very similar to those generated by currently operating nuclear power plants and the construction and operation of these interim LLW storage facilities would be very similar to the construction and operation of the currently operating facilities. Additionally, in the GEIS, the NRC staff concluded that there should be no significant issues or environmental impacts associated with interim storage of LLW generated by nuclear power plants (NRC 2013a). Interim storage facilities would be used until these wastes could be safely shipped to licensed disposal facilities.

Current national policy, as found, for example, in the Nuclear Waste Policy Act (42 U.S.C. 10101 et seq.) mandates that HLWs and transuranic wastes are to be buried at deep geologic repositories. No release to the environment is expected to be associated with deep geologic disposal because it has been assumed that all of the gaseous and volatile radionuclides contained in the spent fuel are released to the atmosphere before the disposal of the waste. In NUREG-0116 (NRC 1976b), which provides background and context for the Table S–3 values established by the Commission, the NRC staff indicates that these HLWs and transuranic wastes will be buried and will not be released to the environment.

As part of the Table S–3 rulemaking, the NRC staff evaluated, along with more conservative assumptions, this zero-release assumption associated with waste burial in a repository, and the NRC reached an overall generic determination that fuel-cycle impacts would not be significant. In 1983, the Supreme Court affirmed the NRC’s position that the zero-release assumption was reasonable in the context of the Table S–3 rulemaking to address generically the impacts of the uranium fuel cycle in individual reactor licensing proceedings (Baltimore Gas & Electric v. Natural Resources Defense Council, 462 U.S. 87(1983)).

Environmental impacts from onsite spent fuel storage have been studied extensively and are well understood. In the context of operating license renewal, the staff (NRC 2013a) provides descriptions of the storage of spent fuel during the licensed lifetime of reactor operations. Radiological impacts are well within regulatory limits; thus, radiological impacts of onsite storage during operations meet the standard for a conclusion of small impact. Nonradiological environmental impacts have been shown to be not significant; thus, they are classified as small. The overall conclusion for onsite storage of spent fuel during the licensed lifetime of reactor operations is that the environmental impacts will be small (NRC 2013a).

The NRC staff concludes, based on Table S–3 and the above conclusions regarding storage of LLW and spent fuel during the licensed lifetime of reactor operations, that the environmental impacts from radioactive waste storage and disposal associated with the operation of Lee Nuclear Station Units 1 and 2 would be SMALL.

Since 1984, the NRC has considered the environmental impacts of spent nuclear fuel storage following the licensed lifetime of reactor operations to be a generic issue that is best addressed through rulemaking. Thus, the Commission’s Waste Confidence Decision and Rule, 10 CFR 51.23, undergirds many agency licensing decisions involving the management of spent nuclear fuel after the licensed life of a reactor. In 2010, the Commission completed its most recent update of the Waste Confidence Decision and Rule, to reflect information gained from experience in the storage of spent nuclear fuel and HLW (75 FR 81032). On June 8, 2012, the U.S. Court of Appeals for the District of Columbia Circuit (the Court) vacated the 2010 Waste Confidence Decision and Rule, finding that it did not comply with the National Environmental Policy Act (NEPA). The Court decision held that (1) the Waste Confidence rulemaking is a major Federal action necessitating either an environmental impact statement (EIS) or a finding of no significant environmental impact, and (2) the Commission's evaluation has several deficiencies in considering the environmental impacts of spent nuclear fuel storage after the licensed life of reactor operation (New York v. NRC 2012).

In response to petitions subsequently filed under multiple NRC hearing dockets that requested suspension of final licensing decisions for applications relying on the vacated Rule, on August 7, 2012, the Commission stated that

> "…in recognition of our duties under the law, we will not issue licenses dependent upon the Waste Confidence Decision or the Temporary Storage Rule until the Court's remand is appropriately addressed. This determination extends just to final license issuance; all current licensing reviews and proceedings should continue to move forward" (NRC 2012h).

On September 6, 2012, the Commission directed the NRC staff to proceed with the development of an EIS to support publication of an updated Waste Confidence Decision and Rule by September 7, 2014 (NRC 2012i). The updated Rule and supporting EIS must address the deficiencies identified in the Court's remand and provide the necessary NEPA assessment of the environmental impacts from long-term storage of spent nuclear fuel following the licensed lifetime of reactor operations. In October 2012, the NRC staff began the NEPA scoping process and established rulemaking docket NRC–2012–0246 (77 FR 65137).

As directed by the Commission in CLI-12-16 (NRC 2012h), the NRC will not issue licenses dependent on the Waste Confidence Decision or Temporary Storage Rule prior to resolution of waste confidence-related issues. This action will ensure that there would be no irretrievable or irreversible resource commitments or potential harm to the environment before waste confidence impacts have been addressed. In the meantime, however, the NRC staff will follow the Commission's instructions to move forward with current licensing reviews and proceedings.

The environmental impacts of spent fuel storage after the licensed life of operations for Lee Nuclear Station Units 1 and 2 are being addressed generically through rulemaking and development of a generic EIS (77 FR 65137). On September 13, 2013, the NRC published a proposed revision of 10 CFR 51.23 (i.e., the Waste Confidence Rule) which generically addresses the environmental impacts of continued storage of spent nuclear fuel beyond the license lifetime of a reactor (78 FR 56776). The NRC also prepared a draft generic EIS to support this Proposed Rule (NRC 2013b). According to the Proposed Rule, no discussion of environmental impacts of spent nuclear fuel storage in a reactor facility storage pool or an independent spent fuel storage installation (ISFSI) for the period following the term of the reactor combined license is required in any EIS prepared in connection with the issuance of a COL for a nuclear power reactor. The Final Rule is scheduled to be published by September 2014. Upon issuance of the Final Rule, the NRC staff will identify any changes between the proposed and final rules; assess the significance of the changes; and, if necessary, perform additional NEPA reviews prior to the final licensing decision for Lee Nuclear Station Units 1 and 2.

6.1.7 Occupational Dose

The annual occupational dose attributable to all phases of the fuel cycle for the 1000-MW(e) LWR-scaled model is about 1800 person-rem. This is based on a 600 person-rem occupational dose estimate attributable to all phases of the fuel cycle for the model 1000-MW(e) LWR (NRC 1996). The NRC staff concludes that the environmental impact from this occupational dose is considered SMALL because the dose to any individual worker would be maintained within the limits of 10 CFR Part 20, which is 5 rem/yr.

6.1.8 Transportation

The transportation dose to workers and the public related to the uranium fuel cycle is approximately 2.5 person-rem annually for the reference 1000-MW(e) LWR in accordance with Table S–3 (Table 6-1). This corresponds to a dose of 7.5 person-rem for the 1000-MW(e) LWR-scaled model. For purposes of comparison, in the year 2016 the population within 50 mi of the Lee Nuclear Station site is estimated to be 2.71 million people (Duke 2009c). Using 0.311 rem/yr as the average dose to a U.S. resident from natural background radiation (NCRP 2009), the collective dose to that population is estimated to be 845,000 person-rem/yr. On the basis of this comparison, the NRC staff concludes that the environmental impacts of transportation would be SMALL.

6.1.9 Conclusions

The NRC staff evaluated the environmental impacts of the uranium fuel cycle as given in Table 6-1, considered the effects of radon-222 and technetium-99, and appropriately scaled the impacts for the 1000-MW(e) LWR-scaled model. The NRC staff also evaluated the environmental impacts of greenhouse gas emissions from the uranium fuel cycle and appropriately scaled the impacts for the 1000 MW(e) LWR-scaled model. Based on this evaluation, the NRC staff concludes that the impacts of the uranium fuel cycle would be SMALL.

6.2 Transportation Impacts

This section addresses both the radiological and nonradiological environmental impacts from normal operating and accident conditions resulting from (1) shipment of unirradiated fuel to the Lee Nuclear Station site, (2) shipment of spent fuel to a monitored retrievable storage facility or a permanent repository, and (3) shipment of low-level radioactive waste and mixed waste to offsite disposal facilities. For the purposes of these analyses, the NRC staff considered the proposed Yucca Mountain site in Nevada as a surrogate destination for a permanent repository. The impacts evaluated in this section for two new nuclear generating units at the Lee Nuclear Station site are appropriate to characterize the alternative sites discussed in Section 9.3 of this EIS. Sites evaluated in this EIS include the Lee Nuclear Station site (proposed), and alternative sites at Perkins, Keowee, and Middleton Shoals. No meaningful differentiation exists among the proposed and the alternative sites regarding the radiological and nonradiological environmental impacts from normal operating and accident conditions; therefore, alternative sites are not discussed further in Chapter 9.

The NRC performed a generic analysis of the environmental effects of transportation of fuel and waste to and from LWRs in the *Environmental Survey of Transportation of Radioactive Materials To and From Nuclear Power Plants*, WASH-1238 (AEC 1972) and in a supplement to WASH-1238, NUREG-75/038 (NRC 1975b) and found the impact to be SMALL. These documents provided the basis for Table S–4 in 10 CFR 51.52, which summarizes the environmental impacts of transportation of fuel and waste to and from one LWR of 3000 to 5000 MW(t) (1000 to 1500 MW(e)). Impacts are provided for normal conditions of transport and accidents in transport for a reference 1100-MW(e) LWR. The transportation impacts associated with the Lee Nuclear Station site were normalized for a reference 1100-MW(e) LWR at an 80-percent capacity factor for comparison with Table S–4.[(a)] Dose to transportation workers during normal transportation operations was estimated to result in a collective dose of 4 person-rem per reference reactor year. The combined dose to the public along the route and to onlookers was estimated as a collective dose of 3 person-rem per reference reactor year.

Environmental risks (radiological) during normal transport and accident conditions, as stated in Table S–4, are small. Nonradiological impacts from postulated accidents were estimated as one fatal injury in 100 reactor years and one nonfatal injury in 10 reference reactor years. Subsequent reviews of transportation impacts in NUREG-0170 (NRC 1977d) and NUREG/CR-6672 (Sprung et al. 2000) concludes that impacts were bounded by Table S–4 in 10 CFR 51.52.

(a) Note that the basis for Table S–4 is an 1100-MW(e) LWR at an 80-percent capacity factor (AEC 1972; NRC 1975b). The basis for Table S–3 in 10 CFR 51.51(b) that was discussed in Section 6.1 of this EIS is an 1000-MW(e) LWR with an 80-percent capacity factor (NRC 1976b). However, because fuel cycle and transportation impacts are evaluated separately, this difference does not affect the results and conclusions in this EIS.

In accordance with 10 CFR 51.52(a), a full description and detailed analysis of transportation impacts are not required when licensing an LWR (i.e., impacts are assumed bounded by Table S–4) if the reactor meets the following criteria:

- The reactor has a core thermal power level not exceeding 3800 MW(t).
- Fuel is in the form of sintered uranium oxide pellets having a uranium-235 enrichment not exceeding 4 percent by weight, and pellets are encapsulated in zirconium-clad fuel rods.
- The average level of irradiation of fuel from the reactor does not exceed 33,000 MWd/MTU, and no irradiated fuel assembly is shipped until at least 90 days after it is discharged from the reactor.
- With the exception of irradiated fuel, all radioactive waste shipped from the reactor is packaged and in solid form.
- Unirradiated fuel is shipped to the reactor by truck; irradiated (spent) fuel is shipped from the reactor by truck, rail, or barge; and radioactive waste other than irradiated fuel is shipped from the reactor by truck or rail.

The environmental impacts of the transportation of fuel and radioactive wastes to and from nuclear power facilities were resolved generically in 10 CFR 51.52 provided that the specific conditions in the Rule (see above) are met; if not, a full description and detailed analysis are required for initial licensing. The NRC may consider requests for licensed plants to operate at conditions above those in the facility's licensing basis; for example, higher burnups (above 33,000 MWd/MTU), enrichments (above 4 percent uranium-235), or thermal power levels (above 3800 MW(t)). Departures from the conditions itemized in 10 CFR 51.52(a) must be supported by a full description and detailed analysis of the environmental effects, as specified in 10 CFR 51.52(b). Departures found to be acceptable for licensed facilities cannot serve as the basis for initial licensing for new reactors.

In its application, Duke requested COLs for proposed Lee Nuclear Station Units 1 and 2. Each proposed new unit would be an AP1000, which has a thermal power rating of 3400 MW(t) and a design gross electrical output of approximately 1200 MW(e) (Duke 2009c). The AP1000s are expected to operate with a 93 percent capacity factor, so the net electrical output (annualized) would be about 1117 MW(e). Fuel for the plants would have an average enrichment of about 4.51 weight percent uranium-235, which exceeds the 10 CFR 51.52(a) condition. In addition, the expected irradiation level of about 62,000 MWd/MTU exceeds the 10 CFR 51.52(a) condition. Therefore, a full description and detailed analysis of transportation impacts is required.

In its environmental report (Duke 2009c), Duke provided a full description and detailed analyses of transportation impacts. In its analyses, radiological impacts of transporting fuel and waste to and from the Lee Nuclear Station and alternative sites were calculated using the RADTRAN 5.6

computer code (Weiner et al. 2008). For this EIS, radiological impacts of transporting fuel and waste to and from the Lee Nuclear Station and alternative sites were estimated using the RADTRAN 5.6 computer code. RADTRAN 5.6 is the most commonly used transportation impact analysis computer code in the nuclear industry, and the NRC staff concludes that the code is an acceptable analysis method.

Based on comments on previous nuclear power plant EISs, an explicit analysis of the nonradiological impacts of transporting workers and construction materials to and from the Lee Nuclear Station and alternative sites is now included. Nonradiological impacts of transporting construction workers and materials and operations workers are addressed in Sections 4.8.3 and 5.8.6, respectively. Publicly available information about traffic accidents, injury, and fatality rates was used to estimate nonradiological impacts. In addition, the radiological impacts to maximally exposed individuals (MEIs) are evaluated.

6.2.1 Transportation of Unirradiated Fuel

The NRC staff performed an independent analysis of the environmental impacts of transporting unirradiated (i.e., fresh) fuel to the Lee Nuclear Station. Radiological impacts of normal operating conditions and transportation accidents as well as nonradiological impacts are discussed in this section. Radiological impacts to populations and MEIs are presented. Because the specific fuel fabrication plant for Lee Nuclear Station unirradiated fuel is not known at this time, the staff's analysis assumes a “representative” route between the fuel fabrication facility and the Lee Nuclear Station site or alternative sites. This means that one analysis was done using a “representative” route with one set of route characteristics (distances and population distributions), and that analysis was used to conclude that the impact from radiation dose would be small for the Lee Nuclear Station site and each of the alternative sites. Once the location of the fuel fabrication site is known, there would likely be small differences in the route and dose estimates for the Lee Nuclear Station site and the alternative sites. However, the radiation doses from transporting unirradiated fuel to the Lee Nuclear Station site and alternative sites would still be small.

6.2.1.1 Normal Conditions

Normal conditions, sometimes referred to as “incident-free” transportation, are transportation activities in which shipments reach their destination without releasing any radioactive material to the environment. Impacts from these shipments would be from the low levels of radiation that penetrate the unirradiated fuel shipping containers. Radiation exposures would occur to (1) persons residing along the transportation corridors between the fuel fabrication facility and the Lee Nuclear Station site; (2) persons in vehicles traveling on the same route as an unirradiated fuel shipment; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers.

Truck Shipments

Table 6-3 provides the NRC staff's estimate of the number of truck shipments of unirradiated fuel for the AP1000 compared to those of the reference 1100-MW(e) reactor specified in WASH-1238 (AEC 1972) operating at 80 percent capacity (880 MW(e)). After normalization, the number of truck shipments of unirradiated fuel to the Lee Nuclear Station site is fewer than the number of truck shipments of unirradiated fuel estimated for the reference LWR in WASH-1238 (AEC 1972).

Table 6-3. Numbers of Truck Shipments of Unirradiated Fuel for Each Advanced Reactor Type

Reactor Type	Number of Shipments per Reactor Unit			Unit Electric Generation, MW(e)[c]	Capacity Factor[c]	Normalized, Shipments per 1100 MW(e)[d]
	Initial Core[a]	Annual Reload	Total[b]			
Reference LWR (WASH-1238)	18	6	252	1100	0.8	252
Lee Nuclear Station AP1000	23	6	257	1117	0.93	244

(a) Shipments of the initial core have been rounded up to the next highest whole number.
(b) Total shipments of unirradiated fuel over a 40-year plant lifetime (i.e., initial core load plus 39 years of average annual reload quantities).
(c) Unit capacities and capacity factors were taken from WASH-1238 (AEC 1972) for the reference LWR and the environmental report (ER) (Duke 2009c) for the AP1000.
(d) Normalized to net electric output for WASH-1238 reference LWR [i.e., 1100-MW(e) plant at 80 percent or net electrical output of 880 MW(e)].

Shipping Mode and Weight Limits

In 10 CFR 51.52, a condition is identified that states all unirradiated fuel is shipped to the reactor by truck. Duke (2009c) specifies that unirradiated fuel would be shipped to the reactor site by truck. Section 10 CFR 51.52 includes a condition that the truck shipments shall not exceed 33,100 kg (73,000 lb) as governed by Federal or State gross vehicle weight restrictions. Duke (2009c) states that the unirradiated fuel shipments to the proposed Lee Nuclear Station site would comply with applicable weight restrictions.

Radiological Doses to Transport Workers and the Public

Section 10 CFR 51.52, Table S–4, includes conditions related to radiological dose to transport workers and members of the public along transport routes. These doses are a function of many variables, including the radiation dose rate emitted from the unirradiated fuel shipments, the number of exposed individuals and their locations relative to the shipment, the time in transit (including travel and stop times), and number of shipments to which the individuals are exposed. For this EIS, the NRC staff independently calculated the radiological dose impacts to transport workers and the public from the transportation of unirradiated fuel using the RADTRAN 5.6 computer code (Weiner et al. 2008).

One of the key assumptions in WASH-1238 (AEC 1972) for the reference LWR unirradiated fuel shipments is that the radiation dose rate 1 m (3.3 ft) from the transport vehicle is 0.001 mSv/hr (0.1 mrem/hr), which is one percent of the regulatory limit. This assumption was also used in the NRC staff's analysis of the AP1000 unirradiated fuel shipments. This assumption is reasonable because the AP1000 fuel materials would be low-dose-rate uranium radionuclides and would be packaged similarly to that described in WASH-1238 (i.e., inside a metal container that provides little radiation shielding). The numbers of shipments per year were obtained by dividing the normalized shipments in Table 6-3 by 40 years of operation. Other key input parameters used in the radiation dose analysis for unirradiated fuel shipments are shown in Table 6-4.

Table 6-4. RADTRAN 5.6 Input Parameters for Fresh Fuel Shipments

Parameter	RADTRAN 5.6 Input Value	Source
Shipping distance, km	3200	AEC (1972)[(a)]
Travel fraction – Rural	0.90	NRC (1977d)
Travel fraction – Suburban	0.05	
Travel fraction – Urban	0.05	
Population density – Rural, persons/km^2	10	DOE (2002a)
Population density – Suburban, persons/km^2	349	
Population density – Urban, persons/km^2	2260	
Vehicle speed – km/hr	88.49	Conservative in transit speed of 55 mph assumed; predominantly interstate highways used
Traffic count – Rural, vehicles/hr	530	DOE (2002a)
Traffic count – Suburban, vehicles/hr	760	
Traffic count – Urban, vehicles/hr	2400	
Dose rate at 1 m from vehicle, mrem/hr	0.1	AEC (1972)
Packaging length, m	7.3	Approximate length of two LWR fuel element packages placed on end
Number of truck crew	2	AEC (1972), NRC (1977d), DOE (2002a)
Stop time, hr/trip	4	Based on one 30-minute stop per 400 km (Griego et al. 1996)
Population density at stops, persons/km^2	See Table 6-8 for truck stop parameters.	

(a) AEC (1972) provides a range of shipping distances between 40 km (25 mi) and 4800 km (3000 mi) for fresh fuel shipments. A 3200-km (2000-mi) "representative" shipping distance was assumed here.

The RADTRAN 5.6 results for this “generic” unirradiated fuel shipment are as follows:

- worker dose: 1.71×10^{-5} person-Sv/shipment (1.71×10^{-3} person-rem/shipment)
- general public dose (onlookers/persons at stops and sharing the highway): 2.95×10^{-5} person-Sv/shipment (2.95×10^{-3} person-rem/shipment)
- general public dose (along route/persons living near a highway or truck stop): 4.17×10^{-7} person-Sv/shipment (4.17×10^{-5} person-rem/shipment).

These values were combined with the average annual shipments of unirradiated fuel for the AP1000 to calculate annual doses to the public and workers. Table 6-5 presents the annual radiological impacts calculated by the NRC staff to workers, public onlookers (persons at stops and sharing the road), and members of the public along the route (i.e., residents within 800 m [0.5 mi] of the highway) for transporting unirradiated fuel to the Lee Nuclear Station site and alternative sites. The cumulative annual dose estimates in Table 6-5 were normalized to 1100 MW(e) (880 MW(e) net electrical output). The NRC staff performed an independent review and determined that all dose estimates are bounded by the Table S–4 conditions of 4 person-rem/yr to transportation workers, 3 person-rem/yr to onlookers, and 3 person-rem/yr to members of the public along the route.

Table 6-5. Radiological Impacts Under Normal Conditions of Transporting Unirradiated Fuel to the Lee Nuclear Station Site

Plant Type	Normalized Average Annual Shipments	Cumulative Annual Dose; person-Sv/yr per 1100 MW(e)[(a)] [880 MW(e) Net]		
		Workers	**Public - Onlookers**	**Public - Along Route**
Reference LWR (WASH-1238)	6.3	1.1×10^{-4}	1.9×10^{-4}	2.6×10^{-6}
Lee Nuclear Station AP1000	6.1	1.2×10^{-4}	2.1×10^{-4}	2.9×10^{-6}
10 CFR 51.52, Table S–4 condition	<1 per day	4.0×10^{-2}	3.0×10^{-2}	3.0×10^{-2}

(a) Multiply person-Sv/yr times 100 to obtain doses in person-rem/yr.

Radiation protection experts assume that any amount of radiation may pose some risk of causing cancer or a severe hereditary effect and that the risk is higher for higher radiation exposures. Therefore, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. A recent report by the National Research Council (2006), the BEIR VII report, uses the linear, no-threshold dose response model as a basis for estimating the risks from low doses. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the NRC staff estimated the risk to the public from radiation exposure using the nominal probability coefficient for total detriment. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem (10,000 person-Sv), equal to 0.00057 effects per person-rem. The coefficient is taken from ICRP's Publication 103 (ICRP 2007).

Both the NCRP and ICRP suggest that when the collective effective dose is smaller than the reciprocal of the relevant risk detriment (in other words, less than 1/0.00057, which is less than 1754 person-rem), the risk assessment should note that the most likely number of excess health effects is zero (NCRP 1995; ICRP 2007). The largest annual collective dose estimate for transporting unirradiated fuel to the Lee Nuclear Station site and alternative sites was 2.0×10^{-2} person-rem, which is less than the 1754 person-rem value that ICRP and NCRP suggest would most likely result in zero excess health effects.

To place these impacts in perspective, the average U.S. resident receives about 311 mrem/yr effective dose equivalent from natural background radiation (i.e., exposures from cosmic radiation, naturally occurring radioactive materials such as radon, and global fallout from testing of nuclear explosive devices) (NCRP 2009). Using this average effective dose, the collective population dose from natural background radiation to the population along this representative route would be about 2.2×10^5 person-rem. Therefore, the radiation doses from transporting unirradiated fuel to the proposed Lee Nuclear Station site and alternative sites are minimal compared to the collective population dose to the same population from exposure to natural sources of radiation.

Maximally Exposed Individuals under Normal Transport Conditions

The NRC staff conducted a scenario-based analysis to develop estimates of incident-free radiation doses to MEIs for fuel and waste shipments to and from the Lee Nuclear Station site. An MEI is a person who may receive the highest radiation dose from a shipment to and/or from the proposed Lee Nuclear Station site. This discussion applies to unirradiated fuel shipments to, and spent fuel and radioactive shipments from the proposed Lee Nuclear Station site and any of the alternative sites. The analysis is based on information in DOE's *Final Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (DOE 2002b) and incorporates information about exposure times, dose rates, and the number of times an individual may be exposed to an offsite shipment. Adjustments were made where necessary to reflect the fuel and waste shipments addressed in this EIS. In all cases, the NRC staff assumed that the dose rate emitted from the shipping containers is 10 mrem/hr 6.6 ft from the side of the transport vehicle, the maximum dose rate allowed by U.S. Department of Transportation (DOT) regulations (49 CFR 173.441), even though most unirradiated fuel and radioactive waste shipments would have much lower dose rates than the regulations allow (AEC 1972; DOE 2002a). The analysis is described below.

Truck crew member. Truck crew members would receive the highest radiation doses during incident-free transport because of their proximity to the loaded shipping container for an extended period of time. The analysis assumed that crew member doses are limited to 2 rem/year, which is the DOE administrative control level presented in DOE-STD-1098-99, *DOE Standard, Radiological Control*, Chapter 2, Article 211 (DOE 2005). This limit is anticipated to apply to shipments of spent nuclear fuel to a disposal facility, because DOE would take title to the spent fuel at the reactor site. There would be more shipments of spent nuclear fuel from the Lee Nuclear Station site or alternative sites than shipments of unirradiated fuel to, and radioactive waste other than spent fuel from, these sites. This is because the capacities of spent fuel shipping casks are limited due to their substantial radiation shielding and accident resistance requirements. Spent fuel shipments would also have significantly higher radiation dose rates than unirradiated fuel and radioactive waste (DOE 2002a). As a result, crew doses from shipments of unirradiated fuel and radioactive waste would be lower than the doses from shipments of spent nuclear fuel. The DOE administrative limit of 2 rem/yr (DOE 2009a) is less than the NRC limit for occupational exposures of 5 rem/yr (10 CFR Part 20).

The DOT does not regulate annual occupational exposures but recommends limits to air crew members that are a 5-year effective dose of 2 rem/yr with no more than 5 rem in a single year (DOT 2003). As a result, a 2-rem/yr MEI dose to truck crews is a reasonable estimate to apply to shipments of fuel and waste from the Lee Nuclear Station site.

Inspectors. Radioactive shipments are inspected by Federal or State vehicle inspectors at, for example, State ports of entry. DOE (2002a) assumed that inspectors would be exposed for 1 hour at a distance of 3.3 ft from the shipping containers. The dose rate at 3.3 ft is about 14 mrem/hr; therefore, the dose per shipment is about 14 mrem. This is independent of the location of the reactor site. Based on this conservative value, the annual doses to vehicle inspectors were calculated by the NRC staff to be about 0.9 rem/yr, assuming the same person inspects all shipments of fuel and waste to and from the proposed Lee Nuclear Station site and alternative sites. This value is about one-half of the 2-rem/yr DOE administrative control level on individual doses and one-fifth of the 5-rem/yr NRC occupational dose limit.

Resident. The analysis assumed that a resident lives adjacent to a highway where a shipment would pass and would be exposed to all shipments along a particular route. Exposures to residents on a per-shipment basis were extracted from RADTRAN 5.6 output files. These dose estimates are based on an individual located 100 ft from shipments that are traveling 15 mph. The potential radiation dose to the maximally exposed resident is 0.039 mrem/yr for shipments of fuel and waste to and from the proposed Lee Nuclear Station site and alternative sites.

Individual stuck in traffic. This scenario addresses potential traffic interruptions that could lead to a person being exposed to a loaded shipment for 1 hour at a distance of 4 ft. The analysis assumed this exposure scenario would occur only one time to any individual, and the dose rate was at the regulatory limit of 10 mrem/hr at 6 ft from the shipment. The dose to the MEI was calculated in DOE (2002a) to be 16 mrem.

Person at a truck service station. This scenario estimates doses to an employee at a service station where all truck shipments to and from the proposed Lee Nuclear Station site are assumed to stop. DOE (2002a) assumed this person is exposed for 49 minutes at a distance of 52 ft from the loaded shipping container. The exposure time and distance were based on the observations discussed by Griego et al. (1996). This results in a dose of 0.34 mrem/shipment and an annual dose of about 23 mrem/yr for the proposed Lee Nuclear Station site and alternative sites, assuming that a single individual services all unirradiated fuel, spent fuel, and radioactive waste shipments to and from the site.

6.2.1.2 Radiological Impacts of Transportation Accidents

Accident risks are a combination of accident frequency and consequence. Accident frequencies for transportation of unirradiated fuel to the Lee Nuclear Station site and alternative sites are expected to be lower than those used in the analysis in WASH-1238 (AEC 1972), the basis for Table S–4 of 10 CFR 51.52, because of improvements in highway safety and security and an overall reduction in traffic accident, injury, and fatality rates since WASH-1238 was published. There is no significant difference in consequences of accidents severe enough to result in a release of unirradiated fuel particles to the environment between the AP1000 and current-generation LWRs because fuel form, cladding, and packaging are similar to those analyzed in WASH-1238. Consequently, the impacts of accidents during transport of unirradiated fuel for advanced LWRs to the proposed Lee Nuclear Station site and alternative sites are expected to be smaller than those listed in Table S–4 for current-generation LWRs.

6.2.1.3 Nonradiological Impacts of Transportation Accidents

Nonradiological impacts are the human health impacts projected to result from traffic accidents involving shipments of unirradiated fuel to the Lee Nuclear Station site and alternative sites; they do not consider radiological or hazardous characteristics of the cargo. Nonradiological impacts include the projected number of traffic accidents, injuries, and fatalities that could result from shipments of unirradiated fuel to the site and return shipments of empty containers from the site.

Nonradiological impacts are calculated using accident, injury, and fatality rates from published sources. The rates (i.e., impacts per vehicle-km traveled) are then multiplied by estimated travel distances for workers and materials. The general formula for calculating nonradiological impacts is as follows:

Impacts = (unit rate) × (round-trip shipping distance) × (annual number of shipments).

In this formula, impacts are presented in units of the number of accidents, number of injuries, and number of fatalities per year. Corresponding unit rates (i.e., impacts per vehicle-km traveled) are used in the calculations.

Accident, injury, and fatality rates were taken from Table 4 in ANL/ESD/TM-150, *State-Level Accident Rates for Surface Freight Transportation: A Reexamination* (Saricks and Tompkins 1999). Nationwide median rates were used for shipments of unirradiated fuel to the site. The data are representative of traffic accident, injury, and fatality rates for heavy truck shipments similar to those to be used to transport unirradiated fuel to the Lee Nuclear Station site. In addition, the DOT Federal Motor Carrier Safety Administration evaluated the data underlying the Saricks and Tompkins (1999) rates, which were taken from the Motor Carrier Management Information System, and determined that the rates were under-reported. Therefore, the accident, injury, and fatality rates in Saricks and Tompkins (1999) were adjusted using factors derived from data provided by the University of Michigan Transportation Research Institute (UMTRI 2003). The UMTRI data indicates that accident rates for 1994 to 1996, the same data used by Saricks and Tompkins (1999), were under-reported by about 39 percent. Injury and fatality rates were under-reported by 16 and 36 percent, respectively. As a result, the accident, injury, and fatality rates were increased by factors of 1.64, 1.20, and 1.57, respectively.

The nonradiological accident impacts calculated by the NRC staff for transporting unirradiated fuel to (and empty shipping containers from) the Lee Nuclear Station site are shown in Table 6-6. The nonradiological impacts associated with the WASH-1238 reference LWR are also shown for comparison. Note that there are only small differences between the impacts calculated for an AP1000 reactor at the Lee Nuclear Station site and the reference LWR in WASH-1238 due entirely to the smaller number of shipments.

Table 6-6. Nonradiological Impacts of Transporting Unirradiated Fuel to the Lee Nuclear Station Site with Single AP1000 Reactor, Normalized to Reference LWR

Plant Type	Annual Shipments Normalized to Reference LWR	One-Way Shipping Distance, km	Annual Round-Trip Distance, km	Annual Impacts		
				Accidents per Year	Injuries per Year	Fatalities per Year
WASH-1238	6.3	3200	4.0×10^4	1.9×10^{-2}	9.3×10^{-3}	5.8×10^{-4}
Lee Nuclear Station	6.1	3200	3.9×10^4	1.8×10^{-2}	9.0×10^{-3}	5.6×10^{-4}

6.2.2 Transportation of Spent Fuel

The NRC staff performed an independent analysis of the environmental impacts of transporting spent fuel from the proposed Lee Nuclear Station site to a spent fuel disposal repository. For the purposes of these analyses, the NRC staff considered the proposed geologic HLW repository at Yucca Mountain in Nevada as a surrogate destination. Currently, the NRC has not made a decision about the DOE application for the proposed geologic repository at Yucca Mountain. However, the NRC staff considers an estimate of the impacts of transportation of spent fuel to a possible repository in Nevada as a reasonable bounding estimate of the transportation impacts to a storage or disposal facility because of the distances involved and the representativeness of the distribution of members of the public in urban, suburban, and rural areas (i.e., population distributions) along the shipping routes. Radiological and nonradiological environmental impacts of normal operating conditions and transportation accidents, as well as nonradiological impacts, are discussed in this section. The NRC Yucca Mountain adjudicatory proceeding is currently suspended and Yucca Mountain-related matters are pending in Federal Court. Regardless of the outcome of these proceedings, the NRC staff concludes that transportation impacts are roughly proportional to the distance from the reactor site to the repository site, in this case South Carolina to Nevada.

The NRC's analysis is based on shipment of spent fuel by legal-weight trucks in shipping casks with characteristics similar to casks currently available (i.e., massive, heavily shielded, cylindrical metal pressure vessels). Each shipment is assumed to consist of a single shipping cask loaded on a modified trailer. These assumptions are consistent with assumptions made in the evaluation of the environmental impacts of transportation of spent fuel in Addendum 1 to NUREG-1437 (NRC 1999a). These assumptions are conservative because the alternatives involve rail transportation or heavy-haul trucks, which would reduce the overall number of spent fuel shipments (NRC 1999a), thus reducing impacts. Also, use of current shipping cask designs results in conservative impact estimates because the current designs are based on transporting short-cooled spent fuel (approximately 120 days out of reactor). Future shipping casks would be designed to transport longer-cooled fuel (greater than 5 years out of reactor) and would require much less shielding to meet external dose limitations. Therefore, future shipping casks are expected to have higher cargo capacities, thus reducing the numbers of shipments and associated impacts.

The NRC staff calculated the radiological impacts of transportation of spent fuel using the RADTRAN 5.6 computer code (Weiner et al. 2008). Routing and population data used in RADTRAN 5.6 for truck shipments were obtained from the Transportation Routing Analysis Geographic Information System (TRAGIS) routing code (Johnson and Michelhaugh 2003). The population data in the TRAGIS code are based on the 2000 census. Nonradiological impacts were calculated using published traffic accident, injury, and fatality data (Saricks and Tompkins 1999) in addition to route information from TRAGIS. The NRC staff adjusted traffic accident rates to account for under-reporting as discussed in Sections 4.8.3 and 6.2.1.3.

6.2.2.1 Normal Conditions

Normal conditions, sometimes referred to as "incident-free" transportation, are transportation activities in which shipments reach their destination without an accident occurring enroute. Impacts from these shipments would be from the low levels of radiation that penetrate the heavily shielded spent fuel shipping cask. Radiation exposures would occur to (1) persons residing along the transportation corridors between the Lee Nuclear Station site and the proposed repository location; (2) persons in vehicles traveling on the same route as a spent fuel shipment; (3) persons at vehicle stops for refueling, rest, and vehicle inspections; and (4) transportation crew workers. For purposes of this analysis, the NRC staff assumed that the destination for the spent fuel shipments is the proposed geologic HLW repository at Yucca Mountain in Nevada. This assumption is conservative because it tends to maximize the shipping distance from the Lee Nuclear Station site and alternative sites.

Shipping casks have not been designed for the spent fuel from advanced reactor designs such as the AP1000. Idaho National Engineering and Environmental Laboratory (INEEL 2003) indicated that advanced LWR fuel designs would not be significantly different from existing LWR designs; therefore, current shipping cask designs were used for the analysis of AP1000 reactor spent fuel shipments. The assumed capacity of a truck shipment of AP1000 reactor spent fuel was 0.5 MTU/shipment, the same capacity as that used in WASH-1238 (AEC 1972).

Input to RADTRAN 5.6 includes the total shipping distance between the origin and destination sites and the population distributions along the routes. This information was obtained by running the TRAGIS computer code (Johnson and Michelhaugh 2003) for shipments from the Lee Nuclear Station site and alternative sites to the proposed geologic HLW repository at Yucca Mountain. The resulting route characteristics, generated by the NRC staff, are shown in Table 6-7.

Table 6-7. Transportation Route Information for Shipments from Lee Nuclear Station Site and Alternative Sites to the Yucca Mountain Spent Fuel Disposal Facility[(a)]

	One-way Shipping Distance, km				Population Density, persons/km^2			Stop Time per Trip, hr
Reactor Site	**Total**	**Rural**	**Suburban**	**Urban**	**Rural**	**Suburban**	**Urban**	
Lee Nuclear Station	4041	3209	754	78	9.7	310.4	2213.8	5
Keowee[(b)]	4044	3153	793	98	9.6	320.6	2285.7	5
Middleton Shoals[(b)]	4019	3144	778	97	9.6	322.4	2286.3	5
Perkins[(b)]	4187	3250	850	86	9.8	317.4	2202.6	5

Source: Johnson and Michelhaugh 2003

(a) This table presents aggregated route characteristics. Input to the RADTRAN 5.6 computer code was disaggregated to a state-by-state level.

(b) The highway distance between the reactor site and the nearest TRAGIS node are included. Google Maps™ was used to determine the highway distance between these sites and the nearest TRAGIS node.

Note that for truck shipments, all the spent fuel is assumed to be shipped to the Yucca Mountain site over designated highway-route controlled-quantity routes. In addition, TRAGIS data was loaded into RADTRAN 5.6 on a state-by-state basis, which increases precision and allows results to be presented for each state along the route between the Lee Nuclear Station site or alternative sites and the proposed geologic HLW repository at Yucca Mountain, if desired.

Radiation doses are a function of many parameters, including vehicle speed, traffic count, dose rate, packaging dimensions, number in the truck crew, stop time, and population density at stops. The values for these parameters and others used in the NRC staff's analysis and the sources of the information are provided in Table 6-8.

Table 6-8. RADTRAN 5.6 Normal (Incident-free) Exposure Parameters

Parameter	RADTRAN 5.6 Input Value	Source
Vehicle speed, km/hr	88.49	Based on average speed in rural areas given in A Resource Handbook on DOE Transportation Risk Assessment (DOE 2002a). Conservative in-transit speed of 55 mph assumed; predominantly interstate highways used.
Traffic count – Rural, vehicles/hr	State-specific	Weiner et al. (2008)
Traffic count – Suburban, vehicles/hr		
Traffic count – Urban, vehicles/hr		
Vehicle occupancy, persons/vehicle	1.5	DOE (2002a)
Dose rate at 1 m from vehicle, mrem/hr	14	DOE (2002a, b) – approximate dose rate at 1 m that is equivalent to maximum dose rate allowed by Federal regulations (i.e., 10 mrem/hr at 2 m from the side of a transport vehicle.
Packaging dimensions, m	Length – 5.2 Diameter – 1.0	DOE (2002b)
Number of truck crew	2	AEC (1972), NRC (1977d), DOE (2002a, b)
Stop time, hr/trip	4	See Table 6-5
Population density at stops, persons/km^2	30,000	Sprung et al. (2000). Nine persons within 10 m of vehicle (see Figure 6-2).
Min/Max radii of annular area around vehicle at stops, m	1 to 10	Sprung et al. (2000)
Shielding factor applied to annular area surrounding vehicle at stops	1 (no shielding)	Sprung et al. (2000)
Population density surrounding truck stops, persons/km^2	340	Sprung et al. (2000)
Min/Max radius of annular area surrounding truck stop, m	10 to 800	Sprung et al. (2000)
Shielding factor applied to annular area surrounding truck stop	0.2	Sprung et al. (2000)

For this analysis, the transportation crew for spent fuel shipments delivered by truck is assumed to consist of two drivers. Escorts were considered but not included because their distance from the shipping cask would reduce the dose rates to levels well below those experienced by the drivers. Stop times were assumed to accrue at the rate of 30 minutes per 4 hours driving time. TRAGIS outputs were used to determine the number of stops. Doses to the public at truck stops have been significant contributors to the doses calculated in previous RADTRAN 5.6 analyses. For this analysis, stop doses are the sum of the doses to individuals located in two annular rings centered at the stopped vehicle, as illustrated in Figure 6-2. The inner ring represents persons who may be at the truck stop at the same time as a spent fuel shipment and extends 1 to 10 m from the edge of the vehicle. The outer ring represents persons who reside near a truck stop and extends from 10 to 800 m from the vehicle. This scheme is similar to that used in Sprung et al. (2000). Population densities and shielding factors were also taken from Sprung et al. (2000), which were based on the observations of Griego et al. (1996).

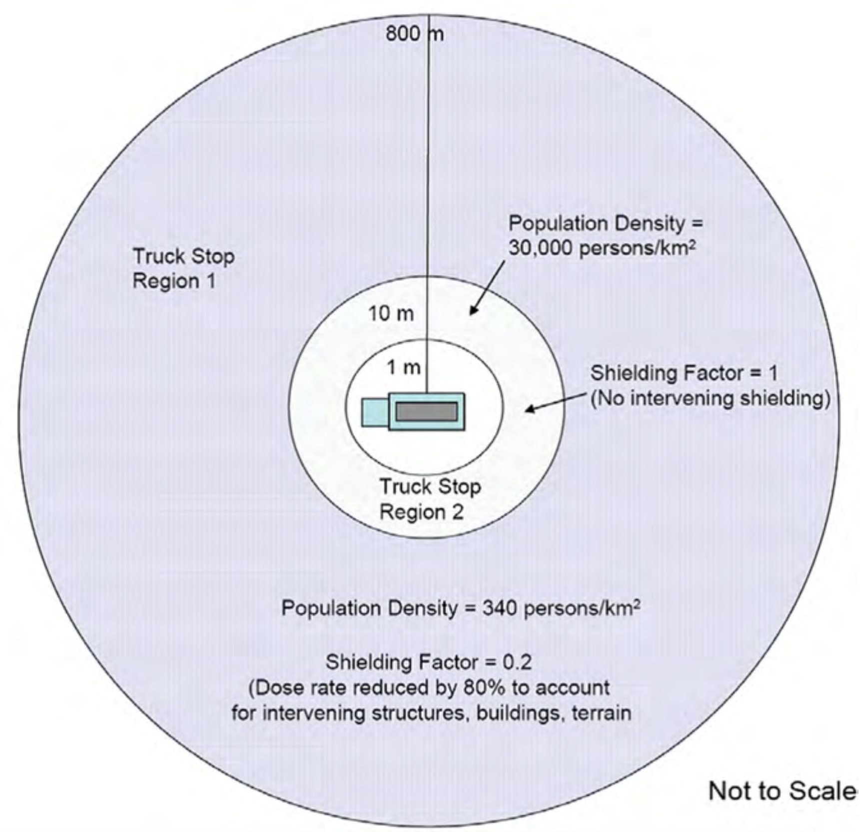

Figure 6-2. Illustration of Truck Stop Model (Sprung et al. 2000)

The results calculated by the NRC staff for these normal (incident-free) exposure calculations are shown in Table 6-9 for the proposed Lee Nuclear Station site. Population dose estimates are given for workers (i.e., truck crew members), onlookers (doses to persons at stops and persons on highways exposed to the spent fuel shipment), and along the route (persons living near the highway). Shipping schedules for spent fuel generated by the proposed new Lee Nuclear Station site units have not been determined. The NRC staff concluded it is reasonable to calculate annual doses assuming that the annual number of spent fuel shipments is equivalent to the annual refueling requirements. Population doses were normalized to the reference LWR in WASH-1238 (880 net MW(e)). This corresponds to an 1100-MW(e) LWR operating at 80 percent capacity.

There are only small differences in transportation impacts among the Lee Nuclear Station site and alternative sites. The differences are due to the route characteristics (e.g., distance and population density) for shipments from the proposed Lee Nuclear Station site and alternative sites to the proposed geologic HLW repository at Yucca Mountain.

Table 6-9. Normal (Incident-Free) Radiation Doses to Transport Workers and the Public from Shipping Spent Fuel from the Lee Nuclear Station Site and Alternative Sites to the Proposed Geologic HLW Repository at Yucca Mountain

	Normalized Impacts, Person-rem/yr[(a)]		
Site and Reactor Type	**Worker (Crew)**	**Onlookers**	**Along Route**
Reference LWR, (WASH-1238)[(b)]	1.1×10^{1}	2.0×10^{1}	2.0×10^{1}
Lee Nuclear Station normalized impacts	7.5×10^{0}	1.3×10^{1}	3.7×10^{-1}
Keowee site normalized impacts	7.5×10^{0}	1.4×10^{1}	4.0×10^{-1}
Middleton Shoals site normalized impacts	7.5×10^{0}	1.3×10^{1}	3.9×10^{-1}
Perkins site normalized impacts	7.8×10^{0}	1.4×10^{1}	4.2×10^{-1}
Table S–4 condition	4×10^{0}	3×10^{0}	3×10^{0}

(a) To convert person-rem to person-Sv, divide by 100.
(b) Based on 60 shipments per year.

The bounding cumulative doses to the exposed population given in Table S–4 are as follows:

- 4 person-rem/reactor-year to transport workers
- 3 person-rem/reactor-year to general public (onlookers) and members of the public along the route.

The calculated population doses to the crew and onlookers for the reference LWR and to onlookers for the Lee Nuclear Station site shipments exceed Table S–4 values. A key reason for the higher population doses relative to Table S–4 is the longer shipping distances assumed for this analysis (i.e., to a possible repository in Nevada) than were used in WASH-1238

(AEC 1972). WASH-1238 used a “typical” distance for a spent fuel shipment of 1000 mi, whereas the shipping distance used in this assessment was about 2500 mi. If the shorter distance were used to calculate the impacts for the Lee Nuclear Station spent fuel shipments, the doses in Table 6-9 could be reduced by half or more. Other important differences are the model related to vehicle stops described above and the additional precision that results from incorporating state-specific route characteristics and vehicle densities on highways (vehicles per hour).

Where necessary, the NRC staff made conservative assumptions to calculate impacts. Some of the key conservative assumptions are the following:

- Use of the regulatory maximum dose rate (10 mrem/hr at 2 m) in the RADTRAN 5.6 calculations. The shipping casks assumed in the EIS prepared by DOE in support of the application for the proposed geologic HLW repository at Yucca Mountain (DOE 2002b) were designed to transport spent fuel that has cooled for 5 years. Most spent fuel will have cooled for much longer than 5 years before it is shipped to a possible geologic repository. Shipments from the Lee Nuclear Station site are also expected to be cooled for longer than 5 years. Consequently, the estimated population doses in Table 6-9 could be further reduced if more realistic dose rate projections and shipping cask capacities are used.
- Use of 30 minutes as the average time at a truck stop in the calculations. Many stops made for actual spent fuel shipments are of short duration (e.g., 10 minutes) for brief visual inspections of the cargo (e.g., checking the cask tie-downs). These stops typically occur in minimally populated areas such as an overpass or freeway ramp in an unpopulated area. Furthermore, empirical data provided in Griego et al. (1996) indicate that 30 minutes is toward the high end of the stop time distribution. Average stop times observed by Griego et al. (1996) are on the order of 18 minutes.

A sensitivity study was performed to demonstrate the effects of using more realistic dose rates and stop times for the incident-free population dose calculations. For this sensitivity study, the dose rate was reduced to 5 mrem/hr, the approximate 50 percent confidence interval of the dose rate distribution estimated by Sprung et al. (2000) for future spent fuel shipments. The stop time was reduced to 18 minutes per stop. All other RADTRAN 5.6 input values were unchanged. The result is that the annual crew doses were reduced to 2.7 person-rem/yr, or about 36 percent of the annual dose shown in Table 6-9. The annual onlooker doses were reduced to 3.6 person-rem/yr (27 percent) and the annual doses to persons along the route were reduced to 1.4×10^{-1} person-rem/yr (37 percent). All of these dose estimates are below the Table S–4 conditions.

Using the linear no-threshold dose response relationship discussed in Section 6.2.1.1, the annual public dose impacts for transporting spent fuel from the Lee Nuclear Station site or alternative sites to Yucca Mountain are about 20 person-rem, which is less than the

1754 person-rem value ICRP (ICRP 2007) and NCRP (NCRP 1995) suggest would most likely result in no excess health effects. This dose is very small compared to the estimated 1.8×10^5 person-rem that the same population along the route from the proposed Lee Nuclear Station site to the proposed geologic HLW repository at Yucca Mountain would incur annually from exposure to natural sources of radiation. Note that the estimated population dose along the route from Lee Nuclear Station site to Yucca Mountain from natural background radiation is different than the natural background dose calculated by the NRC staff for unirradiated fuel shipments in Section 6.2.1.1 of this EIS because the route characteristics are different. A generic route was used in Section 6.2.1.1 for unirradiated fuel shipments and actual highway routes were used in this section for spent fuel shipments.

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and wastes under normal conditions are presented in Section 6.2.1.1.

6.2.2.2 Radiological Impacts of Transportation Accidents

As discussed previously, the NRC staff used the RADTRAN 5.6 computer code to estimate impacts of transportation accidents involving spent fuel shipments. RADTRAN 5.6 considers a spectrum of postulated transportation accidents ranging from those with high frequencies and low consequences (e.g., “fender benders”) to those with low frequencies and high consequences (i.e., accidents in which the shipping container is exposed to severe mechanical and thermal conditions).

Radionuclide inventories are important parameters in the calculation of accident risks. The radionuclide inventories used in this analysis were from Duke’s environmental report (ER) (Duke 2009c) and *Early Site Permit Environmental Report Sections and Supporting Documentation* (INEEL 2003). Spent fuel inventories used in the NRC staff analysis are presented in Table 6-10. The radionuclides listed in the table include all those used in the analysis conducted by Sprung et al. (2000). The analysis also included the inventory of crud (i.e., radioactive material deposited on the external surfaces of LWR spent fuel rods). Because crud is deposited from corrosion products generated elsewhere in the reactor cooling system and the complete reactor design and operating parameters are uncertain, the quantities and characteristics of crud deposited on AP1000 reactor spent fuel are not available at this time. For this analysis, the Lee Nuclear Station spent fuel transportation accident impacts were calculated assuming the cobalt-60 inventory in the form of crud is 120 Ci/MTU, based on information in Sprung et al. (2000).

Robust shipping casks are used to transport spent fuel because of the radiation shielding and accident resistance required by 10 CFR Part 71. Spent fuel shipping casks must be certified Type B packaging systems, meaning they must withstand a series of severe postulated accident conditions with essentially no loss of containment or shielding capability. These casks are also designed with fissile material controls to ensure the spent fuel remains subcritical under normal and accident conditions. According to Sprung et al. (2000), the probability of encountering accident conditions that would lead to shipping-cask failure is less than 0.01 percent (i.e., more than 99.99 percent of all accidents would result in no release of radioactive material from the shipping cask). The NRC staff assumed that shipping casks for AP1000 spent fuel would provide equivalent mechanical and thermal protection of the spent fuel cargo.

Table 6-10. Radionuclide Inventories Used in Transportation Accident Risk Calculations for AP1000

Radionuclide	Ci/MTU[(a)]	Physical-Chemical Group
Pu-241	6.96×10^4	Particulate
Pu-238	6.07×10^3	Particulate
Cm-244	7.75×10^3	Particulate
Am-241	7.27×10^2	Particulate
Pu-240	5.43×10^2	Particulate
Pu-239	2.55×10^2	Particulate
Sr-90	6.19×10^4	Particulate
Cs-137	9.31×10^4	Cesium
Am-243	3.34×10^1	Particulate
Cm-243	3.07×10^1	Particulate
Am-242m	1.31×10^1	Particulate
Ru-106	1.55×10^4	Ruthenium
Eu-154	9.13×10^3	Particulate
Cs-134	4.80×10^4	Cesium
Ce-144	8.87×10^3	Particulate
Sb-125	3.83×10^3	Particulate
Pu-242	1.82×10^0	Particulate
Cm-242	2.83×10^1	Particulate
Pm-147	1.76×10^4	Particulate
Cm-245	1.21×10^0	Particulate
Y-90	6.19×10^4	Particulate
Eu-155	4.62×10^3	Particulate
Co-60[(b)]	1.20×10^2	Crud

(a) The source of the spent fuel inventories is Duke (2009c).
(b) Cobalt-60 is the key radionuclide constituent of fuel assembly crud.

Accident frequencies were calculated in RADTRAN 5.6 using user-specified accident rates and conditional shipping-cask failure probabilities. State-specific accident rates were taken from Saricks and Tompkins (1999) and used in the RADTRAN 5.6 calculations. The state-specific accident rates were adjusted to account for under-reporting, as described in Section 4.8.3.

Conditional shipping-cask failure probabilities (i.e., the probability of cask failure as a function of the mechanical and thermal conditions applied in an accident) were taken from Sprung et al. (2000).

The RADTRAN 5.6 accident risk calculations were performed using radionuclide inventories (Ci/MTU) given in Table 6-10. The resulting risk estimates were then multiplied by assumed annual spent fuel shipments (MTU/yr) to derive estimates of the annual accident risks associated with spent fuel shipments from the proposed Lee Nuclear Station site or alternative sites to the proposed geologic HLW repository at Yucca Mountain in Nevada. The NRC staff assumed that the number of shipments of spent fuel per year is equivalent to the annual discharge quantities.

For this assessment, release fractions for current-generation LWR fuel designs (Sprung et al. 2000) were used to approximate the impacts from the AP1000 reactor spent fuel shipments. This assumes that the fuel materials and containment systems (i.e., cladding, fuel coatings) behave like current LWR fuel under applied mechanical and thermal conditions.

The NRC staff used RADTRAN 5.6 to calculate the population dose from the released radioactive material from four of five possible exposure pathways:[(a)]

- External dose from exposure to the passing cloud of radioactive material (cloudshine)
- External dose from the radionuclides deposited on the ground by the passing plume (groundshine)—the NRC staff's analysis included the radiation exposure from this pathway even though the area surrounding a potential accidental release would be evacuated and decontaminated, preventing long-term exposures from this pathway
- Internal dose from inhalation of airborne radioactive contaminants (inhalation)
- Internal dose from resuspension of radioactive materials deposited on the ground (resuspension)—the NRC staff's analysis included the radiation exposures from this pathway even though evacuation and decontamination of the area surrounding a potential accidental release would prevent long-term exposures.

Table 6-11 presents the environmental consequences calculated by the NRC staff for transportation accidents when shipping spent fuel from the Lee Nuclear Station site or alternative sites to the proposed geologic HLW repository at Yucca Mountain. The shipping distances and population distribution information for the routes were the same as those used for the normal "incident-free" conditions (see Section 6.2.2.1). The results are normalized to the WASH-1238 reference reactor (i.e., 880-MW(e) net electrical generation, 1100-MW(e) reactor operating at 80 percent capacity) to provide a common basis for comparison to the impacts

(a) Internal dose from ingestion of contaminated food was not considered because the NRC staff assumed evacuation and subsequent interdiction of foodstuffs following a postulated transportation accident.

listed in Table S–4. Note that the impacts for all site alternatives are less than the reference LWR impacts. Also, although there are slight differences in impacts among the alternative sites, none of the alternative sites would be clearly favored over the proposed Lee Nuclear Station site or other alternative sites.

Using the linear no-threshold dose response relationship discussed in Section 6.2.1.1, the annual collective public dose estimates for transporting spent fuel from the Lee Nuclear Station site and alternative sites to the proposed geologic repository at Yucca Mountain are on the order of 1×10^{-3} person-rem, which is less than the 1754 person-rem value that ICRP (ICRP 2007) and NCRP (NCRP 1995) suggest would most likely result in zero excess health effects. This risk is very minute compared to the estimated 1.8×10^{5} person-rem that the same population would receive annually along the route from the proposed Lee Nuclear Station site to the proposed geologic HLW repository at Yucca Mountain from exposure to natural sources of radiation.

Table 6-11. Annual Spent Fuel Transportation Accident Impacts for the Proposed Lee Nuclear Station AP1000 and Alternative Sites, Normalized to Reference 1100-MW(e) LWR Net Electrical Generation

	Normalized Population Impacts, Person-rem/yr[(a)]
Reference LWR	1.0×10^{-4}
Lee Nuclear Station site	7.1×10^{-5}
Keowee site	1.3×10^{-4}
Middleton Shoals site	1.3×10^{-4}
Perkins site	8.5×10^{-5}

(a) Divide person-rem/yr by 100 to obtain person-Sv/yr.

6.2.2.3 Nonradiological Impacts of Spent Fuel Shipments

The general approach used to calculate nonradiological impacts of spent fuel shipment transportation accidents is the same as that used for unirradiated fuel shipments. The main difference is that the spent fuel shipping route characteristics are better defined so the state-level accident statistics in Saricks and Tompkins (1999) may be used. State-by-state shipping distances were obtained from the TRAGIS output file and combined with the annual number of shipments and accident, injury, and fatality rates by state from Saricks and Tompkins (1999) to calculate nonradiological impacts. The results are shown in Table 6-12.

Table 6-12. Nonradiological Impacts of Transporting Spent Fuel from the Proposed Lee Nuclear Station Site and Alternative Sites to the Proposed Geologic HLW Repository at Yucca Mountain for a Single AP1000 Reactor, Normalized to Reference LWR

Site	One-Way Shipping Distance, km	Nonradiological Impacts, per year		
		Accidents/yr	Injuries/yr	Fatalities/yr
Lee Nuclear Station	4041	1.1×10^{-1}	7.2×10^{-2}	5.6×10^{-3}
Keowee	4044	1.3×10^{-1}	7.9×10^{-2}	5.8×10^{-3}
Middleton Shoals	4019	1.3×10^{-1}	8.0×10^{-2}	5.8×10^{-3}
Perkins	4187	1.2×10^{-1}	7.6×10^{-2}	5.9×10^{-3}

Note: The number of shipments of spent fuel assumed in the calculations is 39 per year after normalizing to the reference LWR.

6.2.3 Transportation of Radioactive Waste

This section discusses the environmental effects of transporting waste from the Lee Nuclear Station site. The environmental conditions listed in 10 CFR 51.52 that apply to shipments of radioactive waste are as follows:

- Radioactive waste (except spent fuel) would be packaged and in solid form.
- Radioactive waste (except spent fuel) would be shipped from the reactor by truck or rail.
- The weight limitation of 73,000 lb per truck and 100 tons per cask per railcar would be met.
- Traffic density would be less than the one truck shipment per day or three railcars per month condition.

Radioactive waste other than spent fuel from AP1000 reactors at the Lee Nuclear Station site is expected to be capable of being shipped in compliance with Federal or State weight restrictions. Table 6-13 presents the NRC staff's estimates of annual waste volumes and annual waste shipment numbers for an AP1000 at the Lee Nuclear Station normalized to the reference 1100-MW(e) LWR defined in WASH-1238 (AEC 1972). The expected annual radioactive waste volumes for the AP1000 reactor, except for spent fuel, was estimated at 1964 ft^3/yr/unit, and the annual number of waste shipments was estimated at 21 shipments per year (Duke 2009c). The expected annual waste volume is less than that for the 1100-MW(e) reference reactor that was the basis for Table S–4. Therefore, the number of radioactive waste shipments for the AP1000 is smaller than the reference LWR. The NRC staff reviewed the radioactive waste generation and shipment data in the ER (Duke 2009c) and concluded that the information is consistent with current LWR operating experience. Therefore, the number of shipments of radioactive waste, other than spent fuel, to disposal facilities is expected to be smaller than the reference LWR in WASH-1238.

Table 6-13. Summary of Radioactive Waste Shipments from the Lee Nuclear Station

Reactor Type	Waste Generation Information	Annual Waste Volume, m^3/yr/unit	Electrical Output, MW(e) per Unit	Normalized Rate, m^3/ 1100 MW(e) Unit [(a)]	Shipments per 1100 MW(e) Electrical Output[(b)]
Reference LWR (WASH-1238)	3800 ft^3/yr/unit	108	1100	108	46
Lee Nuclear Station AP1000, expected	1964 ft^3/yr/unit[(c)]	56	1117[(c)]	47	21

Conversions: 1 m^3 = 35.31 ft^3. Drum volume = 210 L (0.21 m^3).
(a) Capacity factors used to normalize the waste generation rates to an equivalent electrical generation output are 80 percent for the reference LWR (AEC 1972) and 90 percent for the Lee Nuclear Station AP1000 (Duke 2009c). Waste generation for the AP1000 is normalized to 880 MW(e) net electrical output (1100-MW(e) unit with an 80 percent capacity factor).
(b) The number of shipments per 1100 MW(e) was calculated assuming the WASH-1238 average waste shipment capacity of 2.34 m^3 per shipment (108 m^3/yr divided by 46 shipments per year).
(c) These values were taken from the ER (Duke 2009c).

The sum of the daily shipments of unirradiated fuel, spent fuel, and radioactive waste is well below the one-truck-shipment-per-day condition given in 10 CFR 51.52, Table S–4 for a AP1000 reactor located at the Lee Nuclear Station site. Doubling the shipment estimates to account for empty return shipments of fuel and waste is included in the results.

Dose estimates to the MEI from transport of unirradiated fuel, spent fuel, and waste under normal conditions are presented in Section 6.2.1.1.

Nonradiological impacts of radioactive waste shipments were calculated using the same general approach as unirradiated and spent fuel shipments. For this EIS, the shipping distance was assumed to be 500 mi one way (AEC 1972). Because the actual destination is uncertain, national median accident, injury, and fatality rates were used in the calculations (Saricks and Tompkins 1999). These rates were adjusted to account for under-reporting, as described in Section 4.8.3. The results calculated by the NRC staff are presented in Table 6-14. As shown, the calculated nonradiological impacts for transportation of radioactive waste, other than spent fuel, from the Lee Nuclear Station site to waste disposal facilities are less than the impacts calculated for the reference LWR in WASH-1238.

Table 6-14. Nonradiological Impacts of Radioactive Waste Shipments from an AP1000 Reactor at the Lee Nuclear Station

	Shipments per Year	One-Way Distance, km	Fatalities per Year	Injuries per Year	Accidents per Year
WASH-1238	46	800	1.1×10^{-3}	1.7×10^{-2}	3.4×10^{-2}
Lee Nuclear Station AP1000	21	800	4.9×10^{-4}	7.8×10^{-3}	1.6×10^{-2}

Note: The shipments and impacts have not been normalized to the reference LWR; the expected waste volumes from the Lee Nuclear Station AP1000 were used. Normalized shipments and impacts would be slightly smaller (see Table 6-12).

6.2.4 Conclusions

The NRC staff conducted a confirmatory analysis and performed independent calculations of the impacts under normal operating and accident conditions of transporting construction materials, construction and operations personnel, and fuel and wastes to and from an AP1000 proposed to be located at the Lee Nuclear Station site. To make comparisons to Table S–4, the environmental impacts are normalized to a reference reactor year. The reference reactor is an 1100-MW(e) reactor that has an 80 percent capacity factor, for a total electrical output of 880 MW(e) per year. The environmental impacts can be adjusted to calculate impacts per site by multiplying the normalized impacts by the ratio of the total electric output for the proposed AP1000 at the Lee Nuclear Station to the electric output of the reference reactor.

Because of the conservative approaches and data used to calculate impacts, actual environmental effects are not likely to exceed those calculated in this EIS. Thus, the NRC staff concludes that the environmental impacts of transportation of construction materials, personnel, fuel, and radioactive wastes to and from the Lee Nuclear Station site would be SMALL and consistent with the environmental impacts associated with transportation of materials, personnel, fuel, and radioactive wastes from current-generation reactors presented in Table S–4 of 10 CFR 51.52.

On March 3, 2010, DOE (2010a) submitted a motion to the Atomic Safety and Licensing Board to withdraw with prejudice its application for a permanent geologic repository at Yucca Mountain, Nevada. Regardless of the outcome of this motion, the NRC staff concludes that transportation impacts are roughly proportional to the distance from the reactor site to the repository site, in this case South Carolina to Nevada. The distance from the Lee Nuclear Station site or any of the alternative sites to any new planned repository in the contiguous United States would be no more than double the distance from the Lee Nuclear Station or alternative sites to Yucca Mountain. Doubling the environmental impact estimates from the transportation of spent reactor fuel, as presented in this section, would provide a reasonable bounding estimate of the impacts for NEPA purposes. The NRC staff concludes that the environmental impacts of these doubled estimates would still be SMALL.

6.3 Decommissioning Impacts

At the end of the operating life of a nuclear power reactor, NRC regulations require that the facility be decommissioned. The NRC defines decommissioning as the safe removal of a facility from service and the reduction of residual radioactivity to a level permitting termination of the NRC license. The regulations governing decommissioning of power reactors are found in 10 CFR 50.75 and 10 CFR 50.82. The radiological criteria for termination of the NRC license are in 10 CFR Part 20, Subpart E. Minimization of contamination and generation of radioactive waste requirements for facility design and procedures for operation are addressed in 10 CFR 20.1406.

An applicant for a COL is required to certify that sufficient funds will be available to provide for radiological decommissioning at the end of power operations. As part of its COL application for proposed Units 1 and 2 on the Lee Nuclear Station site, Duke included a Decommissioning Funding Assurance Report (Duke 2010r). Duke would establish an external sinking funds account to accumulate funds for decommissioning.

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors* (GEIS-DECOM) (NRC 2002). Environmental impacts of the DECON, SAFSTOR, and ENTOMB decommissioning methods are evaluated in the GEIS-DECOM. A COL applicant is not required to identify a decommissioning method at the time of the COL application. The NRC staff's evaluation of the environmental impacts of decommissioning presented in the GEIS-DECOM identifies a range of impacts for each environmental issue for a range of different reactor designs. The NRC staff concludes that the construction methods that would be used for the AP1000 are not sufficiently different from the construction methods used for the current plants to significantly affect the impacts evaluated in the GEIS-DECOM. Therefore, the NRC staff concludes that the impacts discussed in the GEIS-DECOM remain bounding for reactors deployed after 2002, including the AP1000.

The GEIS-DECOM does not specifically address the carbon footprint of decommissioning activities. However, it does list the decommissioning activities and states that the decommissioning workforce would be expected to be smaller than the operational workforce and that the decontamination and demolition activities could take up to 10 years to complete. Finally, the GEIS-DECOM discusses SAFSTOR, in which decontamination and dismantlement are delayed for a number of years. Given this information, the NRC staff estimated the CO_2 footprint of decommissioning to be of the order of 105,000 MT for two units without SAFSTOR. This footprint is about equally split between decommissioning workforce transportation and equipment usage. The details of the NRC staff's estimate are presented in Appendix J for a single unit. A 40-year SAFSTOR period would increase the footprint of decommissioning by about 40 percent. These CO_2 footprints are roughly three orders of magnitude lower than the CO_2 footprint presented in Section 6.1.3 for the uranium fuel cycle.

Therefore, the staff relies upon the bases established in GEIS-DECOM and concludes the following:

1. Doses to the public would be well below applicable regulatory standards regardless of which decommissioning method considered in GEIS-DECOM is used.
2. Occupational doses would be well below applicable regulatory standards during the license term.

3. The quantities of Class C or greater than Class C wastes generated would be comparable to or less than the amounts of solid waste generated by reactors licensed before 2002.
4. Air-quality impacts of decommissioning are expected to be negligible at the end of the operating term.
5. Measures are readily available to avoid potential significant water-quality impacts from erosion or spills. The liquid radioactive waste system design includes features to limit release of radioactive material to the environment, such as pipe chases and tank collection basins. These features will minimize the amount of radioactive material in spills and leakage that would have to be addressed at decommissioning.
6. The ecological impacts of decommissioning are expected to be negligible.
7. The socioeconomic impacts would be short-term and could be offset by decreases in population and economic diversification.

On the basis of the GEIS-DECOM and the evaluation of air-quality impacts from greenhouse gas emissions above, the NRC staff concludes that, as long as the regulatory requirements on decommissioning activities to limit the impacts of decommissioning are met, the decommissioning activities would result in a SMALL impact.

7.0 Cumulative Impacts

The National Environmental Policy Act of 1969, as amended (NEPA), requires Federal agencies to consider the cumulative impacts of proposals under its review. Cumulative impacts may result when the environmental effects associated with the proposed action are overlaid or added to temporary or permanent effects associated with past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. When evaluating the potential impacts of two new nuclear units at the William States Lee III Nuclear Station (Lee Nuclear Station) site proposed by Duke Energy Carolinas, LLC (Duke) in its application for combined construction permits and operating licenses (COLs) (Duke 2009c), the U.S. Nuclear Regulatory Commission (NRC) staff and the U.S. Army Corps of Engineers (USACE) staff considered potential cumulative impacts on resources that could be affected by the construction, preconstruction, and operation of two Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water reactors at the site. Cumulative impacts result when the effects of an action are added to, or interact with, other past, present, and reasonably foreseeable future effects on the same resources. For the purposes of this analysis, past actions are those prior to the receipt of the COL application. Present actions are those related to resources from the time of the COL application until the start of NRC-authorized construction of the proposed new units. Future actions are those that are reasonably foreseeable to occur during building and operating the proposed Lee Nuclear Station, including decommissioning. The geographic area over which past, present, and reasonably foreseeable future actions could contribute to cumulative impacts is dependent on the type of resource considered and is described below for each resource area.

The approach for evaluating cumulative impacts in this environmental impact statement (EIS) is outlined in the following discussion. To guide its assessment of environmental impacts of a proposed action or alternative actions, the NRC has established a standard of significance for impacts based on guidance developed by the Council on Environmental Quality (CEQ) (Title 40 of the *Code of Federal Regulations* [CFR] 1508.27). The three significance levels established by the NRC – SMALL, MODERATE, and LARGE – are defined as follows:

SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impacts of the proposed action, as described in Chapters 4 and 5, are combined with other past, present, and reasonably foreseeable future actions near the Lee Nuclear Station site that would affect the same resources affected by proposed Units 1 and 2, regardless of what agency (Federal or non-Federal) or person undertakes such actions. These combined impacts are defined by CEQ as cumulative in 40 CFR 1508.7 and include individually minor but collectively significant actions taking place over a period of time. It is possible that an impact that may be SMALL by itself could result in a MODERATE or LARGE cumulative impact when considered in combination with the impacts of other actions on the affected resource. Likewise, if a resource is regionally declining or imperiled, even a SMALL individual impact could be important if it contributes to or accelerates the overall resource decline.

The description of the affected environment in Chapter 2 serves as the baseline for the cumulative impacts analysis, including the effects of past actions. The incremental impacts related to the construction activities requiring NRC authorization (10 CFR 50.10(a)) are described and characterized in Chapter 4 and those related to operations are described in Chapter 5. These impacts are summarized for each resource area in the sections that follow. The level of detail is commensurate with the significance of the impact for each resource area.

The specific resources and components that could be affected by the incremental effects of the proposed action and other actions in the same geographic area were assessed. This assessment includes the impacts of construction and operation of the proposed new units as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning as described in Chapter 6; and impacts from past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could affect the same resources affected by the proposed actions.

The review team visited the Lee Nuclear Station site from April 28 through May 2, 2008 (NRC 2008d) and the Make-Up Pond C study area from August 9 through 11, 2010 (NRC 2010c). The review team then used the information provided in the environmental report (ER), the Make-Up Pond C supplement to the ER, responses to requests for additional information, information from other Federal and State agencies, and information gathered during the visits to the Lee Nuclear Station and Make-Up Pond C sites to evaluate the cumulative impacts of building and operating two new nuclear power plants at the site. To inform the cumulative analysis, the review team searched U.S. Environmental Protection Agency (EPA) databases for recent EISs and for permits for water discharges in the geographic area (to identify water-use projects and industrial facilities). In addition, the review team used the www.recovery.gov website to identify projects in the geographic area funded by the American Recovery and Reinvestment Act of 2009 (ARRA) (Public Law 111-5). Other actions and projects identified during this review and considered in the review team's independent analysis of the potential cumulative effects are described in Table 7-1. Approximate locations are given with respect to the Lee Nuclear Station site.

Table 7-1. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Cumulative Analysis in the Vicinity of the Lee Nuclear Station Site

Project Name	Summary of Project	Location	Status
Nuclear projects			
Cherokee Nuclear Station	Uncompleted nuclear power plant	At the same location as the proposed Lee Nuclear Station	The site had cooling ponds and some infrastructure in place when work on the Cherokee project was halted in 1982; in 2007 Duke announced the site was chosen for the proposed Lee Nuclear Station (Duke 2009c)
Catawba Nuclear Station Units 1 and 2	Nuclear power plant, two 1129-MW(e) Westinghouse reactors	York, South Carolina, approximately 25 mi east	Operational (NRC 2012a)
McGuire Nuclear Station Units 1 and 2	Nuclear power plant, two 1100-MW(e) Westinghouse reactors	Huntersville, North Carolina, approximately 42 mi northeast	Operational (NRC 2012a)
Virgil C. Summer Nuclear Station (VCSNS) Unit 1	Nuclear power plant, one 996-MW(e) Westinghouse reactor	Jenkinsville, SC, approximately 52 mi south	Operational (NRC 2012a)
VCSNS Units 2 and 3	Nuclear power plant, two 1199.5-MW(e) Westinghouse AP1000 pressurized water reactors	Jenkinsville, SC, approximately 52 mi south	Proposed, operation would begin in 2016 and 2019 (NRC 2011f). COLs issued March 30, 2012 (NRC 2012a)
Independent Spent Fuel Storage Installation	Dry spent fuel storage at the VCSNS site	Jenkinsville, SC, approximately 52 mi south	Proposed (NRC 2011f)
Carolinas-Virginia Tube Reactor	Experimental pressurized tube heavy water nuclear power reactor	Jenkinsville, SC, approximately 55 mi south-southeast	Decommissioned 2010 (SCE&G 2011)
Oconee Nuclear Station, Units 1, 2, and 3	Nuclear power plant, three 846-MW(e) Babcock and Wilcox pressurized water reactors	Seneca, SC, approximately 80 mi west	Operational (NRC 2012a)

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Westinghouse Fuel Manufacturing Plant	Design and fabricate completed nuclear fuel assemblies and fuel-related products	Columbia, SC, approximately 87 mi south-southeast	Operational (Westinghouse 2009)
H.B. Robinson Steam Electric Plant Unit 2	Nuclear power plant, one 710-MW(e) Westinghouse reactor	Hartsville, SC, approximately 89 mi southeast	Operational (NRC 2012a)
Nuclear Fuel Services, Inc. Erwin Plant	Prepares high-enriched uranium and fabrics fuel for use in U.S. Department of Energy Naval Reactor Program. Also recovers high-enriched uranium from scrap, and blends high-enriched uranium with natural uranium to produce low-enriched uranium.	Erwin, Tennessee, approximately 91 mi northwest	Operational. License SNM-124 renewed August 2, 2012. Licensed through August 31, 2037 (NRC 2012j)
Coal and natural gas energy projects			
Columbia Gas Transmission Corporation Grover Compressor Station	Natural gas compressor station	Blacksburg, SC, approximately 4 mi north	Operational (EPA 2010c)
Broad River Energy Center	Gas-fired power plant, 847 MW	Gaffney, SC, approximately 5 mi northwest	Operational (EPA 2010d)
Cherokee County Cogeneration	60-MW gas-fired turbine generator, and 26-MW condensing steam turbine generator	Gaffney, SC, approximately 6 mi northwest	Operational (EPA 2010e)
Mill Creek Combustion Turbine Station	Gas-fired power plant, 640 MW	Cherokee County, 10 mi northeast on Kings Creek, tributary of the Broad River	Operational (EPA 2011d; Duke Energy 2010e)
Cleveland County Power Plant	Gas-fired power plant, 720 MW	Cleveland County, NC; approximately 11 mi northeast	Operational (Southern Power 2012)
Cliffside Steam Station Unit 6	Coal-fired power plant (clean coal unit), 825 MW	Cleveland and Rutherford Counties, NC, approximately 20 mi northwest	Operational (Duke Energy 2013a)

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Cliffside Steam Station Units 5	Coal-fired power plant, 562 MW	Cleveland and Rutherford Counties, NC, approximately 20 mi northwest	Operational (Duke Energy 2013a)
Lincoln Combustion	Gas-fired power plant, 1200 MW	Lincoln County, NC, approximately 38 mi northeast	Operational (Duke Energy 2010b)
Riverbend Steam Station	454-MW coal-fired power plant permanently shut down in March 2013	Gaston County, NC, approximately 38 mi northeast	Ceased Operations (Duke 2013d)
Various smaller electrical generation plants	35 electrical plants capable of generating <20 MW each	Within 50 mi	Operational
Hydroelectric energy projects on the Broad River			
Ninety-Nine Islands Hydroelectric Project	Hydroelectric power plant, 18 MW	South-adjacent to Lee Nuclear Station	Operational, licensed through 2036 (Duke Energy 2010d; FERC 2011c)
Cherokee Falls Hydraulic Turbine	Hydroelectric power plant, 4.3 MW	Gaffney, SC, approximately 2 mi northwest on the Broad River	Operational, licensed through 2021 (FERC 2011b)
Gaston Shoals Hydraulic Turbines	Hydroelectric power plant, 6.7 MW	Gaston Shoals, approximately 9 mi northwest on the Broad River	Operational, licensed through 2036 (Duke Energy 2010d)
Lockhart Dam	Hydroelectric power plant, 18 MW	Approximately 17 mi south on the Broad River	Operational, licensed through 2040 (FERC 2011b)
Upper Pacolet Hydroelectric Project	Hydroelectric power plant, 0.84 MW	Approximately 17 mi southwest on the Pacolet River, a tributary to the Broad River	Proposed (FERC 2009; 74 FR 68815

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Neal Shoals Hydroelectric Project	Hydroelectric power plant, 4.4 MW	Approximately 26 mi south on the Broad River	Operational, licensed through 2036 (FERC 2011b)
Mining projects adjacent to the Broad River and within 5 mi of the Lee Nuclear Station site			
Thomas Sand Co.	Sand mining	Approximately 1 mi west-northwest	Operational (USGS 2010c)
Thomas Sand Co./Blacksburg Plant	Sand and gravel mining	Approximately 8 mi east-southeast	Operational (USGS 2010c)
Browns Sand Dredge	Sand and gravel mining	Approximately 10 mi northwest	Operational (USGS 2010d)
Cunningham Brick/Martin Mine	Clay, ceramic, and refractory minerals	Approximately 4 mi northeast	Operational (EPA 2011e)
Hanson Brick East/Sericite Pit	Clay, ceramic, and refractory minerals	Approximately 4 mi northeast	Operational (EPA 2010g)
Industrial Minerals Number 2	Minerals and earths, ground or otherwise treated	Approximately 4 mi northeast	Operational (EPA 2010h)
Industrial Minerals, Inc.	Miscellaneous nonmetallic minerals	Approximately 4 mi northeast	Operational (EPA 2010i)
Red Clay-Higgins	Common clay and shale	Approximately 5 mi north	Operational (USGS 2010e)
P&L Erosion/Carroll Dr Mine	Miscellaneous nonmetallic minerals	Approximately 5 mi north	Operational (EPA 2010j)
Water supply and treatment facilities on the Broad River and major tributaries			
City of Gaffney/Peoples Creek PLT	Wastewater treatment facility on the Broad River, permitted flow at discharge pipe 4 million gallons per day (Mgd)	Approximately 3 mi northwest	Operational, major National Pollutant Discharge Elimination System (NPDES) domestic permit No. SC0047091 (EPA 2010k)
City of Gaffney/Clary Waste Water Treatment Plant	Wastewater treatment facility on Thicketty Creek (tributary to the Broad River), permitted flow at discharge pipe 5 Mgd	Approximately 8 mi east	Operational, major NPDES domestic permit No. SC0031551 (EPA 2010l)
City of Gaffney water supply	Withdrawals up to 18 Mgd from Broad River	Approximately 7 mi north-northwest	Operational (GBPW 2010)

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Spartanburg Sanitary Sewer District/Town of Cowpens/Pacolet River Wastewater Treatment Plant	Wastewater treatment facility on the Pacolet River (tributary to the Broad River); permitted flow at discharge pipe 1.5 Mgd	Approximately 12 mi west	Operational, NPDES domestic permit No. SC0045624 (EPA 2008c)
Spartanburg Sanitary Sewer District/Fairforest Creek Wastewater Treatment Plant	Wastewater treatment facility that discharges to the Pacolet River and Fairforest Creek; permitted flow at discharge pipe 19 Mgd	Approximately 16 mi west-southwest	Operational, major NPDES domestic permit No. SC0020435 (EPA 2006)
Shelby, North Carolina Wastewater Treatment Plant	Discharges to the First Broad River	Approximately 15 mi north-northwest	Operational, major NPDES permit No. NC0024538 (EPA 2010m)
Shelby, North Carolina water supply	Withdrawals water from the First Broad River	Approximately 17 mi northwest	Operational (City of Shelby 2007)
Kings Mountain, North Carolina water supply	Withdrawals water from Kings Mountain Reservoir, upstream of Lee Nuclear Station	Approximately 17 mi north-northeast	Operational (NCDEH 2010a)
Union, South Carolina water supply	Withdrawals water from the Broad River upstream of Lee Nuclear Station	Approximately 21 mi south	Operational (surface-water user downstream of Lee) (EPA 2011f)
Cleveland County Water Board	Withdrawals water from the First Broad River upstream of Lee Nuclear Station	Lawndale, NC, approximately 26 mi north	Operational (NCDEH 2010b, EPA 2010n)
Cleveland County Water Board	1200 ac proposed reservoir off the First Broad River	Lawndale, NC, approximately 26 mi northwest	Proposed (USACE 2009b)
Forest City, North Carolina water supply	Withdrawals water from the Second Broad River	Approximately 28 mi northwest	Operational (NCDEH 2010c)
Broad River Water Authority	Withdrawals water from the Broad River	Rutherford, North Carolina, approximately 35 mi northwest	Operational (NCDEH 2010d)
Manufacturing facilities within 20 mi			
SC Distributors, Inc.	Fabric mill along Broad River	Approximately 3 mi northwest	Operational, minor NPDES permit No. SC0002755 (EPA 2010o)

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
National Textiles, LLC/Coker International, LLC	Knitwear mill and fabric finishing plant that discharges to the Broad River; permitted flow at discharge pipe 0.0005 Mgd	Approximately 5 mi northwest	Operational, minor NPDES industrial permit No. SC0035947 (EPA 2010p)
Hanson Brick, Blacksburg Plant	Brick and clay tile manufacturing	Approximately 6 mi north	Operational; minor NPDES permit No. SC000155 (EPA 2010q)
Milliken and Co. Magnolia Finishing Plant	Fabric finishing plant that discharges to the Broad River; permitted flow at discharge pipe 3.89 Mgd	Approximately 6.5 mi northwest on Buffalo Creek	Operational, major NPDES industrial permit No. SC0003182 (EPA 2010r)
Core Molding Technologies, Inc.	Plastics manufacturing	Approximately 7 mi northwest	Operational, minor NPDES permit No. SCG250199 (EPA 2010s)
BIC Corporation	Manufactures pens and mechanical pencils	Approximately 7 mi northwest	Operational (EPA 2010t)
Bommer Industries	Electroplating, plating, polishing and anodizing metals	Approximately 11 mi west-northwest	Operational (EPA 2010u)
Accurate Plating, Inc.	Electroplating, plating, polishing and anodizing metals	Approximately 12 mi west	Operational (EPA 2010v)
CNA Holdings Inc., Shelby Plant	Manufactures plastics and synthetic resins	Approximately 12 mi north	Operational, major NPDES permit No. NC0004952, discharges to Buffalo Creek, tributary to Broad River (EPA 2010w)
Linpac (US Corrugated)	Paperboard mill	Approximately 15 mi west	Operational (EPA 2010x)
Chemetall Foote Corp.	Miscellaneous inorganic chemical manufacturing	Approximately 16 mi northeast	Operational (EPA 2010y)
Invista SARL / Spartanburg	Plastics materials and resins manufacturing; discharges to the Pacolet River; monitor and report for NPDES compliance	Approximately 17 mi east	Operational major NPDES permit No. SC0002798 (EPA 2010z)

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Various minor NPDES wastewater discharges	Various businesses with smaller wastewater dischargers to waterbodies	Within 10 mi	Operational
Transportation			
South Carolina Strategic Corridor System Plan	Strategic system of corridors forming the backbone of the State's transportation system. A planning document exists with no explicit schedules for projects. Includes SC 11 to S 42 near Spartanburg, SC 161 to US 321 through York, SC 72 to S 46 near Chester, US 123 to US 29 mostly to the south of Cherokee County.	South Carolina (Statewide)	In progress (SCDOT 2009a)
ARRA grants to SC Dept. of Transportation	$5 million for highway infrastructure improvements in Cherokee County	Within 20 mi	In progress (ARRA 2011)
Parks, national forests, and historic sites			
Broad Scenic River	The Broad River is classified as a State Scenic River, 15 mi long from Ninety-Nine Islands Dam to confluence with Pacolet River	Broad River, 1 to 16 mi downstream	Managed by the South Carolina Department of Natural Resources (SCDNR 2009d)
Kings Mountain State Park	6885 ac with hiking, fishing, and horse trails	Approximately 10 mi northeast	Managed by the South Carolina Department of Parks, Recreation & Tourism (SCSP 2011a)
Kings Mountain National Military Park	Historic site, hiking	Approximately 10 mi northeast	Managed by the National Park Service (NPS 2010)
Crowders Mountain State Park	Camping, hiking	Kings Mountain, NC, Approximately 11 mi northeast	Managed by North Carolina Division of Parks & Recreation (NCDPR 2011)
Cowpens National Battlefield	Historic battlefield	Chesnee, SC, Approximately 18 mi northwest	Managed by the National Park Service (NPS 2011a)

Table 7-1. (contd)

Project Name	Summary of Project	Location	Status
Sumter National Forest	371,000 ac National Forest	Approximately 20 mi south	Currently managed by U.S. Forest Service (USFS 2004a)
Croft State Natural Area	7054 ac natural area with bike, horse, and hiking trails	Spartanburg, SC, approximately 22 mi southwest	Managed by the South Carolina Department of Parks, Recreation & Tourism (SCSP 2011b)
Chester State Park	523 ac area for hiking, boating, and fishing	Chester, SC, approximately 28 mi southwest	Managed by the South Carolina Department of Parks, Recreation & Tourism (SCSP 2011c)
Rose Hill Plantation State Historic Site	44 ac plantation	Union, SC, approximately 30 mi south-southwest	Managed by the South Carolina Department of Parks, Recreation & Tourism (SCSP 2011d)
Other projects			
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and rail; and water and/or wastewater treatment and distribution facilities and associated pipelines as described in local land-use planning documents	Throughout region	Construction would occur in the future, as described in State and local land-use planning documents

7.1 Land-Use Impacts

The description of the affected environment in Section 2.2 serves as a baseline for the following cumulative assessment of land-use impacts. As described in Section 4.1, the impacts of NRC-authorized construction activities on land use would be SMALL and no further mitigation would be required. As described in Section 5.1, the land-use impacts of operations would be SMALL, and no further mitigation would be warranted.

The combined impacts from construction and preconstruction are also described in Section 4.1 and have been determined by the review team to be MODERATE, primarily due to the extensive acreage that would be inundated or otherwise excluded from other uses to accommodate Make-Up Pond C and development of new transmission-line corridors. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could affect land use. For the cumulative analysis of land use, the geographic area of interest is considered to be the 50-mi region described in Section 2.2.4. The geographic area of interest encompasses the Lee Nuclear Station site and vicinity, the proposed Make-Up Pond C site, the railroad corridor, the two proposed transmission-line corridors, and the offsite road-improvement areas, as well as other areas where land use could be affected by one or more Lee Nuclear Station features. Roads and other public facilities and services in rural areas tend to serve people who are spread thinly but broadly over large portions of the landscape. Therefore, land-use changes can affect roads and other facilities at greater distances than similar changes in more densely populated areas.

The Lee Nuclear Station site is located in a sparsely populated, largely rural area, where forests and pasture land are the predominant land uses. The Piedmont terrain varies from gently rolling to hilly and is punctuated by relatively narrow stream valleys. Historically, most upland areas have been used for crop production, but many are presently used for silviculture. Gaffney and Blacksburg are the closest communities. Several electric transmission lines, state highways, and interstate highways currently traverse the area. Industries and facilities that have historically affected land use near the Lee Nuclear Station site are described in Table 7-1. The geographic area of interest has changed dramatically since the damming of the Broad River by Ninety-Nine Islands Dam in 1910. Prior to impoundment, land now inundated was primarily forestland, riparian land, and farmland (SCDNR 2003). No part of the geographic area of interest is located in the coastal zone.

The proposed project would indirectly result in land conversions to residential areas, roads, and businesses to accommodate growth, new workers, and services related to the proposed nuclear facility. Other reasonably foreseeable projects in the area that could contribute to an increase in urbanization include potential development of new residences along McKowns Mountain Road and other rural roadways within easy commuting distance of the new plant. This would result in a conversion of farmland, pastures, and forests to residential areas. The amount of land converted to residences, roads, or businesses would be minimal compared to the amount of land available in the area.

As described in Section 4.1, development of the Lee Nuclear Station project would permanently occupy approximately 619 ac and temporarily occupy an additional 327 ac, for a total footprint of approximately 946 ac on a site encompassing approximately 1928 ac (Duke 2013d). The site therefore appears to be large enough to readily accommodate the proposed footprint with only minimal encroachment on environmentally sensitive land (e.g., wetlands, floodplains, and prime farmland). Much of the site was cleared during the partial development of the unfinished

Cherokee Nuclear Station, which was halted in 1982. Of the estimated 946 ac of total onsite land needed to build and operate the proposed new facilities, about 585 ac would be located within the footprint of the earlier Cherokee Nuclear Station development work and only about 361 ac would be located elsewhere on the site (Duke 2013d). The review team expects that the anticipated land demands within the Lee Nuclear Station site would not noticeably alter land-use patterns within the geographic area of interest.

However, the proposed project would have substantial offsite land demands. Approximately 1100 ac of offsite land, mostly on a 2110-ac outparcel termed the Make-Up Pond C site, would be permanently or temporarily occupied for the development of Make-Up Pond C (Duke 2013d). About 3 ac of those 1100 ac would be on land close to the Make-Up Pond C site rather than on the site itself. In addition, approximately 31 mi of new transmission-line corridors would be established in offsite areas not adjacent to existing transmission-line corridors (Duke 2011h). The transmission-line corridors would occupy an estimated 987 ac of offsite land. These impacts outside of the Lee Nuclear Station site would noticeably alter land-use patterns within the geographic area of interest.

Farmland of Statewide-importance and/or prime farmland exists on the Lee Nuclear Station site (2 ac) and the Make-Up Pond C site (260 ac); this land would be unavailable for farming during the operating life of proposed Lee Nuclear Station Units 1 and 2. Loss of this farmland is not expected to noticeably alter agricultural activity in the vicinity or region. In addition, approximately 163 ac of the proposed transmission-line corridors are considered prime farmland, or farmland of Statewide-importance. However, Duke allows farming and crop production within transmission-line corridors and expects limitations to these conditions related only to where transmission structures are located. Impacts to wetlands are discussed in Section 7.3.

Because the other projects described in Table 7-1 do not include any substantial reasonably foreseeable changes in types of land use within 50 mi of the Lee Nuclear Station site, other than general growth and urbanization development discussed above, no additional substantive cumulative impacts on land use would result from those activities.

Cumulative land-use impacts within the geographic area of interest would not be inconsistent with existing land-use plans or zoning. As discussed in Sections 4.1 and 5.1, Duke's proposed land-use changes do not involve zoning conflicts and are not expected to result in other land-use conflicts. Although Duke had to displace several existing residences to acquire and prepare the land needed for Make-Up Pond C, Duke provided relocation services (as needed) for property owners and renters. After purchasing the property, Duke allowed former homeowners to remain in their homes from 1 to 18 months rent-free to find other living arrangements. Renters were usually given between 30 and 90 days' notice to vacate the property (Duke 2009b).

Primarily because of the extensive land demands needed to build Make-Up Pond C and the new transmission-line corridors, the review team concludes that the cumulative land-use impacts associated with the proposed Lee Nuclear Station, related facilities, and other projects in the geographic area of interest would be MODERATE. Development of Make-Up Pond C and the new transmission-line corridors is the principal contributor to the MODERATE conclusion for cumulative land-use impacts. The expected contribution from the projects in Table 7-1, including general urbanization in the surrounding landscape, is expected to be minimal. Because neither transmission-line corridor nor Make-Up Pond C development requires NRC authorization, the NRC staff concludes that the incremental impacts from NRC-authorized activities would be SMALL.

7.2 Water-Related Impacts

This section addresses the cumulative impacts of proposed Lee Nuclear Station Units 1 and 2, and other past, present, and reasonably foreseeable future projects on water use and quality.

7.2.1 Water-Use Impacts

This section describes the cumulative water-use impacts from construction, preconstruction, and operation of the proposed Lee Nuclear Station Units 1 and 2, in addition to and other past, present, and reasonably foreseeable future projects.

7.2.1.1 Surface-Water-Use Impacts

The description of the affected environment in Section 2.3 of this document serves as a baseline for surface-water use. As described in Section 4.2.2.1, the impacts from NRC-authorized construction on surface-water use would be SMALL, and no further mitigation would be warranted. As described in Section 5.2.2.1, the review team concludes that the impacts of operations on surface-water use would also be SMALL, and no further mitigation would be warranted.

The combined surface-water-use impacts from construction and preconstruction are described in Section 4.2.2.1 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis for surface-water use considers other past, present, and reasonably foreseeable future actions that could potentially affect this resource. For the cumulative analysis of impact on surface-water use, the geographic area of interest is the drainage basin of the Broad River upstream and downstream of the Lee Nuclear Station site because other actions within this region could result in a cumulative impact. The Broad River has provided water for agricultural, industrial, and municipal use since colonial times. Dams have been installed on the river to provide flood control, increase the reliability of water supply to the region, and provide power. On the Lee Nuclear Station site, work on the unfinished Cherokee Nuclear Station resulted in alteration of surface water through site grading and the development of Make-Up Ponds A and B. Key actions that have current and reasonably foreseeable future potential impacts on the surface-water use in the Broad River basin include operation of Ninety-Nine Islands Hydroelectric Project and building and operation of the Virgil C. Summer Nuclear Station (VCSNS) Units 2 and 3.

Peak water needs during construction and preconstruction, as described in Section 4.2.2.1, are estimated to be approximately 0.39 cubic feet per second (cfs). This water would be obtained from the Draytonville Water District (see Table 3-5). The impact of its use would not be noticeable in the Broad River basin. The surface-water-use impacts of construction, preconstruction, and operation are dominated by the higher water demands that would occur under normal operation. The projected consumptive water use by the proposed units is expected to be 55 cfs, which is 3 percent of the Broad River mean annual flow of 1858 cfs at the gage near the site and below Ninety-Nine Islands Dam, as described in Section 5.2.2.1. This mean river flow reflects upstream cumulative consumptive uses of current users. Increases in consumptive use of water in the Broad River drainage are anticipated in the future.
Duke Energy has prepared an assessment of water availability and project use for the Broad River to determine the availability of water to support expansions of Duke's generating capability (Duke Energy 2007). Duke Energy considered future agriculture and irrigation projects, power projections, public water supplies and wastewater projections, and future industrial use. Duke Energy also considered future trends in water use such as water reuse, water conservation, and changes in regulations and the regional economy. The Duke Energy study does not consider the impact of climate change. The study indicates the consumptive water use would increase in the Broad River drainage from the 241.5 cfs (0.33 acre-feet per year [ac-ft/yr]) in 2006 to 412.9 cfs (0.57 ac-ft/yr) by 2070. Duke Energy (2007) asserts that the study will enable resource agencies in the Broad River basin to plan for water needs and develop water-storage facilities necessary to support future water needs. Because proposed Lee Nuclear Station Units 1 and 2 and VCSNS Units 1, 2, and 3 would all rely on water from reservoirs during periods of low flow, impacts would not likely alter surface-water resources in the Broad River. The impacts of other projects listed in Table 7-1 are considered in the analysis included in Sections 4.2 and 5.2 or would have little or no impact on the surface-water use.

The review team is also aware of potential climate changes that could affect the water resources available for cooling and the impacts of reactor operations on water resources for other users. A recent compilation of the state of the knowledge in this area (GCRP 2009) has been considered in the preparation of this EIS. Projected changes in the climate for the region during the life of the proposed units include an increase in average temperature of 2 to 3°F and a decrease in precipitation in the winter, spring, summer and a small increase in the fall (GCRP 2009). Changes in climate during the life of the proposed units could result in either an increase or decrease in the amount of precipitation; the divergence in the model projections for the southeastern United States precludes a definitive estimate (GCRP 2009). Based on a review of the GCRP (2009) assessment of the southeastern United States, the review team conservatively estimated a decrease in streamflow of 10 percent over the license period of the station. This would reduce the long-term mean annual flow by approximately 250 cfs. Based on the Duke Energy (2007) water-use report, the predicted upstream future water use would further reduce the mean annual flow by approximately 63 cfs (Duke Energy 2007). Therefore, the combined reduction in streamflow at the Lee Nuclear Station site, including operation of Lee Nuclear Station Units 1 and 2 (55 cfs consumptive use), would be 368 cfs, or 15 percent of the long-term mean annual flow.

Based on the potential decreases in the future water supply, the review team determined that the cumulative impact during construction, preconstruction, and operation of the proposed Lee Nuclear Station on surface-water use would be MODERATE. The incremental impact associated with water use for operation of Lee Nuclear Station Units 1 and 2 was determined not to be a significant contributor to this cumulative impact.

7.2.1.2 Groundwater-Use Impacts

The description of the affected environment in Section 2.3 of this EIS serves as the baseline for the cumulative impact assessments in this resource area. As described in Section 4.2.2.2, the impacts from NRC-authorized construction on groundwater would be SMALL and no further mitigation would be warranted. As described in Section 5.2.2.2, the review team concludes that the impacts of operations on groundwater use would also be SMALL, and no further mitigation would be warranted.

The combined groundwater-use impacts from construction and preconstruction are described in Section 4.2.2.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis for groundwater use considers other past, present, and reasonably foreseeable future actions that could potentially affect this resource. For the cumulative analysis of impacts on groundwater, two geographic areas of interest have been identified: the Lee Nuclear Station site and the Make-Up Pond C site. The geographic area of interest affected by dewatering activities for construction and preconstruction activities at the Lee Nuclear Station site is limited to a roughly circular area extending approximately 1700 ft from the center of the excavation, (i.e., an onsite area bounded by Make-Up Pond B, Make-Up Pond A, and Hold-Up Pond A; see Figure 2-11). The geographic area of interest affected by dewatering activities for construction and preconstruction activities at the Make-Up Pond C site would be limited to the immediate vicinity of the dam and abutment, because other construction and preconstruction activities at Make-Up Pond C are not expected to require dewatering.

The two geographic areas of interest are essentially the watersheds that overlie and provide recharge to the aquifer. Groundwater would not be used as a source of water for the construction, preconstruction, or operation of proposed Lee Nuclear Station Units 1 and 2 including Make-Up Pond C; therefore, the groundwater geographic areas of interest are local to the sites (i.e., a regional aquifer is not used as a water supply).

As discussed in Section 4.2.2.2, groundwater will not be a source of water during construction and preconstruction; therefore, onsite groundwater withdrawal would not contribute to a cumulative impact offsite. Private groundwater wells are located on the property adjacent to the Lee Nuclear Station site and the Make-Up Pond C site. As noted in Section 4.2.2.2, offsite wells in the vicinity of the Lee Nuclear Station site would not be influenced by onsite activities. Offsite wells located adjacent to Make-Up Pond C may be influenced by the filling of Make-Up Pond C during the construction and preconstruction period. The water level in the wells adjacent to the pond would rise in response to filling Make-Up Pond C to its maximum pool elevation of 650 ft.

While some residents still rely on groundwater wells, in the last decade the Draytonville Water District has provided potable water service to the region, and individuals are moving to the public water supply (Duke 2008b, 2009c). In 2009, an estimated 83 percent of residents within 2 mi of the Lee Nuclear Station site have the public water supply available to them; 59 percent are served by the system. In 2004 these numbers were 57 and 38 percent, respectively (Duke 2008b). The Draytonville Water District obtains its water from the Gaffney Board of Public Works, and Gaffney withdraws the water from the Broad River. Therefore, the public water supply does not affect the groundwater resource.

The review team has examined the cumulative consumptive use of groundwater including the construction and preconstruction of the proposed units and the potential effects on the groundwater resource from other past, present, and reasonably foreseeable future actions. The review team identified only the past action of the unfinished Cherokee Nuclear Station as potentially affecting the groundwater resource. Reshaping the landscape of the unfinished Cherokee Nuclear Station site removed elevated areas, created a plateau for the three proposed units and several onsite waterbodies (i.e., Make-Up Ponds A and B, and Hold-Up Pond A), and excavated for deep foundations in the power block area. This landscape, which is changed from the preconstruction condition of the unfinished Cherokee Nuclear Station site, forms the initial preconstruction landscape for the Lee Nuclear Station site. In terms of its physical setting (e.g., height, connectedness to surface waterbodies, presence within fill material), the original groundwater aquifer has changed in response to this reshaped environment. However, the water resource it represents in terms of a water source and its water quality are consistent with the pre-site conditions documented in the application for the unfinished Cherokee Nuclear Station (Duke 2009c). For this reason the review team concludes that cumulative impacts of construction and preconstruction on the groundwater resource from other past, present, and reasonably foreseeable future actions would be minimal.

As discussed in Section 5.2.2.2, impacts on groundwater use during operations are anticipated to be SMALL because Duke does not plan to use groundwater or to discharge waste to groundwater during operations at either the Lee Nuclear Station site or the Make-Up Pond C site. Impacts on groundwater use in Cherokee County from operations are not anticipated because Lee Nuclear Station would obtain all water for operations directly from the Broad River and the Draytonville Water District. Offsite wells located adjacent to Make-Up Pond C influenced during the filling of the pond during construction and preconstruction would also be influenced by the discharge and refill of Make-Up Pond C during operation of proposed Lee Nuclear Station Units 1 and 2. If influenced at all, the water level within wells would rise in response to the full-pond water level of 650 ft above mean sea level, and fall no lower than their preconstruction levels. The review team has examined the cumulative consumptive use of groundwater including the operation of the proposed units, and other consumptive uses (past, present, and reasonably foreseeable future uses). Given that no industrial, agricultural, or power generation uses are identified for groundwater, the review team concludes that the cumulative impact on groundwater use during operation would be minimal.

Based on its evaluation, the review team concludes that the cumulative impacts on groundwater use during construction, preconstruction, and operation of proposed Lee Nuclear Station Units 1 and 2 would be SMALL.

7.2.2 Water-Quality Impacts

This section describes cumulative water-quality impacts resulting from construction, preconstruction, and operation of the proposed units and impacts from other past, present, and reasonably foreseeable future projects.

7.2.2.1 Surface-Water-Quality Impacts

The description of the affected environment in Section 2.3 serves as a baseline for this resource area. As described in Section 4.2.3.1, the impacts from NRC-authorized construction on surface-water quality would be SMALL and no further mitigation would be warranted. As described in Section 5.2.3.1, the review team concludes that the impacts of operations on surface-water quality would also be SMALL, and no further mitigation would be warranted. The analysis of operational impacts in Section 5.2.3.1 accounted for the NPDES permit (Permit No. SC0049140) issued by the South Carolina Department of Health and Environmental Control (SCDHEC) to Duke on July 17, 2013 and effective September 1, 2013 (SCDHEC 2013a). In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis for surface-water quality considers other past, present, and reasonably foreseeable future actions that could potentially affect this resource.

As described in Section 4.2.3.1, the surface-water-quality impacts from construction and preconstruction would be SMALL, and no further mitigation would be warranted. In addition to the impacts from construction, preconstruction and operations, the cumulative analysis considers past, present, and reasonably foreseeable future actions that could impact surface-water quality. For this cumulative analysis the geographic area of interest is the Broad River basin, the same as that described for surface-water use (Section 7.2.1.1).

The impacts on water quality from building and operating proposed Lee Nuclear Station Units 1 and 2 were determined to be minimal, and were evaluated using the current conditions in the Broad River. The hydrological conditions described in Sections 4.2 and 5.2 include the impact of activities listed as currently operational in Table 7-1 that are distinct from the activities at the site. These activities include facilities other than the proposed Lee Nuclear Station Units 1 and 2 with NPDES permits to discharge water to the Broad River and its tributaries. The NPDES permit program for point source discharges and the Total Maximum Daily Load program for nonpoint sources are designed to protect water quality.

The review team performed an independent assessment of the primary water-quality impacts on Ninety-Nine Islands Reservoir and the Broad River in its analysis of the estimated blowdown discharge of proposed Lee Nuclear Station Units 1 and 2 (see Section 5.3). The review team determined that both the thermal impacts and the impact of discharging solutes and solids concentrated through evaporation in the cooling towers would be minimal and localized to the zone defined by the thermal plume. The impacts of the other projects listed in Table 7-1 are either considered in the analysis included in Sections 4.2 and 5.2 or would have little or no impact on surface-water quality. Based on the predicted increase in temperature associated with climate change (see 7.2.1.1), the review team determined that the temperature of the streamflow in the Broad River is similarly likely to increase. However, the projected temperature increase is not expected to result in a significant decrease in the beneficial uses of the Broad River.

Although the cumulative effects on surface-water quality may be detectable, they would not noticeably alter the resource; therefore, the review team concludes that cumulative impacts of surface-water quality would be SMALL.

7.2.2.2 Groundwater-Quality Impacts

The description of the affected environment in Section 2.3 of this document serves as a baseline for the cumulative impacts assessments in this resource area. The groundwater-quality impacts for NRC-authorized construction are described in Section 4.2.3.2 and were determined to be SMALL and no further mitigation would be warranted. As described in Section 5.2.3.2, the review team concludes the groundwater-quality impacts from operation of the proposed units would also be SMALL and no further mitigation would be warranted.

The combined groundwater-quality impacts from construction and preconstruction are described in Section 4.2.3.2 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis for groundwater quality considers other past, present, and reasonably foreseeable future actions that could potentially impact this resource. The geographic area of interest is the same as that described for groundwater use (Section 7.2.1.2).

As discussed in Section 4.2.3.2, impacts on groundwater quality would be localized and temporary during construction and preconstruction. Aside from the unfinished Cherokee Nuclear Station, no past, present, and reasonably foreseeable actions in the local watersheds that recharge aquifers underlying the Lee Nuclear Station site and the Make-Up Pond C site would potentially affect the groundwater resource. The review team's review of the effects of the unfinished Cherokee Nuclear Station in Section 7.2.1.2 applies, and the review team concludes that cumulative impacts on the groundwater resource from other past, present, and reasonably foreseeable future actions would be minimal.

Impacts on groundwater quality during operations, as discussed in Section 5.2.3.2, are anticipated to be localized because Duke does not plan to use groundwater or to discharge waste to groundwater during operations. The minimal impact to groundwater quality in groundwater wells located adjacent to Make-Up Pond C during discharge and fill events is noted in Section 5.2.3.2.

The cumulative effects on groundwater quality may be detectable on a single-well or group-of-wells basis, but not on a regional basis. The review team concludes that cumulative effects would be minor such that they would neither destabilize nor noticeably alter the groundwater resource. Therefore, the review team concludes that the cumulative impacts to groundwater quality during construction, preconstruction, and operation would be SMALL.

7.3 Ecological Impacts

This section addresses the potential cumulative impacts on ecological resources from building and operating Lee Nuclear Station; building and operating Make-Up Pond C); building and operating transmission-line and water-pipeline corridors; renovating and partially rerouting a railroad-spur corridor; making offsite road improvements, and past, present, and reasonably foreseeable future activities within the geographic area of interest of each resource.

7.3.1 Terrestrial Ecology and Wetlands

The description of the affected environment in Chapter 2.4.1 provides the baseline for the cumulative impacts assessments for terrestrial and wetland ecological resources. As described in Section 4.3.1, the impacts from NRC-authorized construction on terrestrial and wetlands ecology would be SMALL, and no further mitigation would be warranted. As described in Section 5.3.1, the impacts of operations on terrestrial and wetlands ecology would be SMALL, and no further mitigation would be warranted.

The combined impacts from preconstruction and NRC-authorized construction were also described in Section 4.3.1 and determined by the review team to be MODERATE, primarily because of the impacts from development of Make-Up Pond C and the transmission-line corridors. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could affect terrestrial resources. For the cumulative analysis of potential impacts to terrestrial and wetland ecology, the geographic area of interest is a 15-mi radius around the proposed Lee Nuclear Station, which encompasses Make-Up Pond C, the railroad-spur corridor, the water-pipeline corridor, the two proposed transmission-line corridors, and the offsite road improvements. The geographic area of interest is located within two subdivisions of the Piedmont ecoregion of South Carolina: the Kings Mountain subdivision and the Southern Outer Piedmont subdivision. The Kings Mountain subdivision includes the proposed Lee Nuclear Station and associated facilities with the exception of the terminal portions of the transmission-line corridors, which are in the Southern Outer Piedmont subdivision (EPA 2007b). The two subdivisions are similar in terms of previous disturbances and existing land covers (Glenn et al. 2002) and are indicative of the Piedmont ecoregion as a whole. This area is expected to encompass the ecologically relevant landscape features, habitats, and species potentially affected by the Lee Nuclear Station.

7.3.1.1 Habitat

The Piedmont ecoregion has been altered to a greater extent than the other ecoregions of South Carolina since the time of European settlement, primarily because of farming, agriculture, and silviculture. During the time of early settlement, the forests were primarily a mixture of oaks (*Quercus* spp.), hickories (*Carya* spp.), and shortleaf pine (*Pinus echinata*), which are still the prevalent vegetation types in the Piedmont. The introduction of cotton farming changed much of the original hardwood and pine forests into agricultural fields. By the 1930s, various factors, including the Great Depression, severe erosion, and boll weevil (*Anthonomus grandis*) outbreaks, led to widespread abandonment of farmlands. Loblolly pine (*P. taeda*), introduced during the nineteenth century as a cash lumber crop, is currently the dominant tree species throughout much of the ecoregion (SCDNR 2005). Most forests in the geographic area of interest are a mosaic, dominated by privately owned monotypic pine plantations and natural mixed hardwood-pine and pine-mixed hardwood forest located on regenerating old field sites and other previously disturbed sites (Glenn et al. 2002).

The geographic area of interest has changed dramatically since the damming of the Broad River by Ninety-Nine Islands Dam in 1910. Prior to impoundment, the land currently inundated was primarily forestland, riparian land, and farmland (Duke 2011h, SCDNR 2003). Other dams in the geographic area of interest that have likewise impounded riparian and upland habitat include Gaston Shoals Dam on the Broad River in 1927 (Duke 2011h) and the damming of Cherokee Creek in 1964 to create Lake Whelchel (Duke 2009c). Land alteration occurred on the Lee Nuclear Station site from 1977 through 1982 during construction of the incomplete Cherokee Nuclear Station (Duke 2009c). During that period, Duke Power Company cleared and graded approximately 750 ac of the more than 1900-ac site for the unfinished Cherokee Nuclear Station and impounded riparian and upland habitats associated with approximately 23,000 linear ft of streams to create Make-Up Ponds A and B (Duke 2011h) (Section 2.4.1.1). In 1971, the South Carolina Department of Natural Resources (SCDNR) impounded riparian and upland habitat associated with about 1 mi of London Creek and associated headwater tributaries to create Lake Cherokee (Duke 2009b, 2011h). In addition, over the years, many small ponds have been created (for flood control, stormwater, irrigation, water supply, recreation, etc.) that have flooded riparian and upland habitat (Duke 2011h).

Overlaying the historic impacts described above, current projects within the geographic area of interest include numerous surface mining operations; several hydroelectric and gas-fired energy plants; several manufacturing facilities; several wastewater treatment plants; transportation projects; Kings Mountain National Military Park; several State parks (e.g., Kings Mountain State Park, which adjoins Kings Mountain National Military Park, and Crowders Mountain State Park); the Broad Scenic River; and continued silviculture, agriculture, farming, and urbanization (Table 7-1). The development of most of these projects has further reduced, fragmented, and degraded natural forests and decreased their connectivity. In contrast, the scenic river designation protects the natural resources of the designated section of the Broad River corridor in perpetuity. The Kings Mountain National Military Park and State parks also protect local terrestrial resources in perpetuity.

Most of the geographic area of interest of today remains rural and consists of scattered, privately owned pine plantations and pine-hardwood forests on upland sites; regenerating mixed hardwood and mixed hardwood-pine forest on relatively narrow floodplains and upland sites; small farms and recently abandoned farmland; agriculture fields such as pasture and hay; limited commercial development; single family residences; the City of Gaffney; and open water (e.g., Ninety-Nine Islands Reservoir and the Broad River and its tributaries). The landscape, which once was almost continuously forested, now exhibits fragmentation and degradation. Reasonably foreseeable projects and land uses within the geographic area of interest that could affect wildlife habitat include ongoing silviculture, farming, and agricultural development and limited commercial, residential, and urban development, particularly in conjunction with the Interstate 85 corridor (Duke 2011h).

Site preparation and development of the proposed Lee Nuclear Station and associated facilities would disturb a total of about 2824 ac, of which about 1934 ac is forest, including 545 ac of mixed hardwood forest and mixed hardwood-pine forest at the Make-Up Pond C site. In addition, four noteworthy ecological associations of concern to the State of South Carolina, seven significant natural areas, and habitat that supports populations of rare species, including one Federal candidate plant species and five State-ranked plant species, would be permanently lost via inundation and/or site development. The loss of habitat, particularly forest habitat along the two transmission-line corridors and the bottomland mixed-hardwood forest along London Creek and its tributaries, would noticeably reduce, fragment, and degrade natural forest habitat and decrease its connectivity in the geographic area of interest.

Although the habitat in the geographic area of interest has been significantly altered since the time of European settlement, habitat impacts from the projects and activities listed above, with the exception of the Broad River scenic river designation, Kings Mountain National Military Park, and State parks, combined with building and operating the proposed Lee Nuclear Station, would be noticeable but not destabilizing to terrestrial resources because the affected habitat types are generally common in the geographic area of interest.

7.3.1.2 Wetlands

Historically, the majority of South Carolina's wetlands were in the eastern half of the state, with relatively few in the Piedmont (Dahl 1999). The original Piedmont wetlands probably featured numerous depressions of swamp tupelo (*Nyssa biflora*) and willow oak (*Quercus phellos*) that served as natural "green-tree reservoirs" for ducks and other wildlife. The severe erosion of farmland soil and the abandonment of farmland during the Great Depression led to the sedimentation of an unknown amount of Piedmont wetlands (SCDNR 2005). In 1989, wetlands made up 21 percent of the state's land area, but less than 5 percent of the state's wetlands were located in the geographic area of interest (Dahl 1999). Hydroelectric projects may have had greater wetland impacts than other past activities, but actual acreages of previous wetland removal resulting from the activities listed in Table 7-1 are not known for the geographic area of interest. Currently available wetlands in the geographic area of interest are primarily scattered along creeks and rivers (Duke 2007c).

Site preparation and development of the proposed Lee Nuclear Station and required ancillary features such as Make-Up Pond C, two new transmission-line corridors, and railway spur would result in direct impacts to 5.43 ac of jurisdictional wetlands and 29.63 ac of open waters (Table 9-19) (Duke 2012n). In addition, temporary drawdown of Make-Up Ponds A and B during installation of intake/refill structures has the potential to result in temporary secondary impacts to an additional 5.46 ac of jurisdictional wetlands along the shoreline. Affected wetlands comprise approximately 0.35 percent of the total projected disturbed area. Unavoidable impacts to wetlands and streams would be mitigated through compensatory mitigation. A summary of Duke's mitigation plan, as provided by the USACE, is included in Section 4.3.1.7. Duke consulted with the USACE to develop a compensatory mitigation plan in conformance with the requirements of the USACE Charleston, South Carolina District's *Guidelines for Preparing a Compensatory Mitigation Plan, Working Draft* (USACE 2010a) and *Compensatory Mitigation for Losses of Aquatic Resources; Final Rule* (73 FR 19594, 40 CFR Part 230 and 33 CFR Part 332). A watershed-based, permittee-responsible mitigation project or projects, including restoration, preservation, and enhancement, would be used to compensate for unavoidable project impacts on wetlands and streams (Duke 2010o). It is likely that a relatively minor amount of wetland habitat has been or would be removed by past, present, and reasonably foreseeable future activities in the geographic area of interest, including the proposed Lee Nuclear Station. Consequently, wetland impacts are considered minor in the geographic area of interest.

7.3.1.3 Wildlife

The wildlife that occupies an area at any given time is indicative of the habitat that supports it. As noted in Section 7.3.1.1, oak-hickory forests dominated the Piedmont prior to European settlement. Pre-settlement oak-hickory forests experienced natural surface fires that were frequent and of low intensity. Frequent fires created a mosaic of habitat in various stages of succession, which ranged from prairie to mature forest. Consequently, it is likely that wildlife species adapted to all stages of succession were present, including those that required large blocks of habitat (i.e., area-sensitive species), such as the bobwhite quail (*Colinus virginianus*), and those that prefer interior forest habitat, such as the scarlet tanager (*Piranga olivacea*) and hooded warbler (*Wilsonia citrina*) (SCDNR 2005).

The extensive forest clearing and low-intensity agriculture that accompanied early settlement dramatically increased the amount of early successional (prairie-like) and edge habitat (forest/open habitat interface) in the Piedmont, which peaked in the early twentieth century. However, during the second half of the twentieth century, the quantity and quality of early successional habitats diminished due to fire suppression, fragmentation of habitat into small isolated units due to the establishment of pine plantations and smaller-scale farming and agriculture operations, increasing land development, and encroachment of invasive vegetation (e.g., Chinese privet [*Ligustrum sinense*]). Populations of many wildlife species that depend on open habitats also declined during this time period. Today, the only known remnant of Piedmont prairie habitat is located on the eastern fringe of York County, South Carolina, outside the geographic area of interest (SCDNR 2007). Hardwood forests generally are not allowed to mature because of timber harvest rotation schedules and pine plantations generally provide poor wildlife habitat. Consequently, the current landscape habitat mosaic in the Piedmont, and in the geographic area of interest, favors wildlife adapted to mid-successional hardwood forest conditions, pine plantations, and/or small farm fields (e.g., pasture). Current habitat does not favor prairie or late-successional (i.e., mature forest) wildlife, or wildlife that require large blocks of habitat.

Reasonably foreseeable projects within the geographic area of interest that would affect wildlife populations include the ongoing silviculture, farming, and agriculture and the expected limited commercial, residential, and urban development, especially that surrounding Interstate 85 (Duke 2011h) described in Section 7.3.1.1. These influences would perpetuate reduction, fragmentation, and degradation of natural hardwood forests and decrease habitat connectivity. The resulting habitat mosaic would tend to continue to favor wildlife adapted to mid-successional hardwood forest conditions and generally worsen conditions for wildlife adapted to prairie and late-successional conditions. It would also continue to favor species adapted to a fragmented forested landscape rather than species favoring broad, unbroken swaths of forest.

The removal of large blocks of upland habitat for the proposed Lee Nuclear Station and associated facilities would cause wildlife mortality, disturbance, and displacement. Less mobile animals would incur greater mortality than more mobile animals, which would be displaced into nearby undisturbed habitat where increased competition for resources may result in population reductions. Riparian species, especially amphibians, would be lost from the bottomland mixed hardwood forest habitat along London Creek. Species adapted to open habitats could be lost from extant farm fields and scrub-shrub habitats, but could disperse into similar adjacent habitats. Similarly, species adapted to forest/clearing edge habitats could disperse into other areas created by inundation or forest clearing. Thus, the proposed Lee Nuclear Station and associated facilities would pose short-term temporary adverse impacts for some wildlife species that use early successional habitat or edge environments. However, riparian and bottomland hardwood forest species would face long-term mortality, disturbance, and displacement.

Although wildlife resources in the geographic area of interest have been significantly altered since the time of European settlement, impacts to wildlife resulting from ongoing and reasonably foreseeable future activities, including the proposed Lee Nuclear Station, would not be destabilizing, but would be noticeable for some groups of wildlife (e.g., late-successional [mature forest] wildlife or wildlife that require large blocks of habitat).

7.3.1.4 Important Species

Five South Carolina State-ranked plant species: (1) drooping sedge (*Carex prasina*) (imperiled [S2]), (2) southern enchanter's nightshade (*Circaea lutetiana* ssp*. canadensis*) (vulnerable [S3]), (3) southern adder's-tongue fern (*Ophioglossum vulgatum*) (imperiled [S2]), (4) Canada moonseed (*Menispermum canadense*) (imperiled [S2]), and (5) single-flowered cancer root (*Orobanche uniflora*) (imperiled [S2]) and a State-ranked avian species, the loggerhead shrike (*Lanius ludovicianus*) (vulnerable [S3]), would be affected by the proposed Lee Nuclear Station and associated facilities. A total of 16 additional State-ranked plant species and one State-ranked animal species are also known to occur in the geographic area of interest, although they were not found within the project footprint (Section 2.4.1.6, Table 2-9, Footnote [c]). Four noteworthy ecological associations of concern to the SCDNR would be affected by the creation of Make-Up Pond C. In addition, two plant communities of interest to the SCDNR also occur within the geographic area of interest: basic forest (State-ranked as imperiled [S2]) and pine-oak heath (State-ranked as vulnerable [S3]) (SCDNR 2012b). The State ranks of these species and communities range from vulnerable (S3) to imperiled (S2) in South Carolina, but all are generally secure range-wide, which includes much of eastern North America (NatureServe Explorer 2010; SCDNR 2012b). Although the past, present, and reasonably foreseeable future activities described in Section 7.3.1.1, including the proposed Lee Nuclear Station and associated facilities, have affected, and would continue to affect, individual populations of these species and occurrences of these communities, cumulative effects in the geographic area of interest would have a negligible impact on these species and communities range-wide.

Georgia aster (*Symphyotrichum georgianum*), a Federal candidate species, also would be affected by development of Make-Up Pond C (Section 4.3.1.6). The species occurs in five southeastern states, including South Carolina. It is considered vulnerable range-wide (NatureServe Explorer 2010). Georgia aster is an early successional relict species of the post oak (*Quercus stellata*) savanna/prairie of the Piedmont. The species currently occupies a variety of dry habitats along roadsides; along woodland borders; in dry, rocky woods; and in utility corridors on low-acidic or highly-alkaline soil where current land management mimics natural disturbance (FWS 2010a). Reasonably foreseeable projects within the geographic area of interest that would affect the species include ongoing silviculture and farming; agricultural development; and limited commercial, residential, and urban development described in Section 7.3.1.1. Although range-wide losses of Georgia aster populations and suitable habitat for the species resulting from past, present, and reasonably foreseeable future activities are considered noticeable and potentially destabilizing (as indicated by the species being a candidate for Federal listing as threatened or endangered), cumulative effects in the geographic area of interest, including the proposed Lee Nuclear Station and associated facilities, would not be expected to have more than a minor impact on the species range-wide.

7.3.1.5 Summary of Terrestrial Impacts

Cumulative impacts to terrestrial and wetland resources from construction, preconstruction, and operation of the proposed Lee Nuclear Station and other past, present, and reasonably foreseeable projects were estimated based on the information provided by Duke, the U.S. Fish and Wildlife Service (FWS), the SCDNR, and the review team's independent evaluation. Terrestrial resources in the geographic area of interest have been significantly altered since the time of European settlement. Ongoing silviculture and farming; agricultural development; and commercial, residential, and urban development, would continue to reduce, fragment, and degrade terrestrial resources in the geographic area of interest.

The loss of habitat associated with the proposed Lee Nuclear Station and associated facilities, especially lowland mixed-hardwood forest along London Creek and its tributaries and forest habitat along transmission-line corridors, would noticeably impact but not destabilize terrestrial resources in the geographic area of interest. Impacts to wetlands and important species, including the Georgia aster, would be minimal. Unavoidable impacts to wetlands and streams would be mitigated through compensatory mitigation as discussed in Section 4.3.1.7.

Based on this evaluation, the review team concludes that cumulative impacts from past, present, and reasonably foreseeable future actions, including construction, preconstruction, and operations of the proposed Lee Nuclear Station, to terrestrial ecology and wetland resources in the geographic area of interest would be MODERATE. Although impact from the development of the Lee Nuclear Station site would be considerable, development of Make-Up Pond C and the transmission-line corridors are the principal contributors to the MODERATE rating of cumulative terrestrial impacts. While impacts from the development of Make-Up Pond C and the proposed transmission-line corridors would noticeably impact terrestrial resources within the

15-mi geographic area of interest, cumulative impacts over the range of occurrence for the affected habitat and wildlife (i.e., the Piedmont ecoregion) would not be destabilizing.

Neither Make-Up Pond C development nor development of the transmission-line corridors requires NRC authorization. Incremental impacts from NRC-authorized activities (which are limited to the Lee Nuclear Station site and confined mostly to the low-quality habitats within the previously disturbed footprint of the unfinished Cherokee Nuclear Station) do not significantly contribute to the impact, and would not noticeably alter the terrestrial ecology within the geographic area of interest.

7.3.2 Aquatic Ecosystem

The description of the affected environment in Section 2.4.2 serves as a baseline for the cumulative impacts assessment for aquatic ecological resources. As described in Section 4.3.2, the impacts of NRC-authorized construction activities on aquatic biota would be SMALL, and no further mitigation would be warranted. As described in Section 5.3.2, the review team concludes that impacts of Lee Nuclear Station Units 1 and 2 operations and maintenance on aquatic resources inhabiting onsite waterbodies, Make-Up Pond C, the Broad River, and waterbodies crossed by the transmission-line corridors would be SMALL.

The combined impacts on aquatic resources from construction and preconstruction, including building new cooling-water intake and discharge systems, dredging and other soil-disturbing activities during modification of structures in Make-Up Ponds A and B, temporarily drawing down Make-Up Ponds A and B to facilitate cofferdam installation, installing a dam across London Creek with the subsequent impoundment of London Creek and its unnamed tributaries, filling Make-Up Pond C, installing pump stations and an intake/discharge facility at Make-Up Pond C, installing new transmission-line corridors, renovating the railroad-spur culvert crossing, and breaching and draining offsite farm ponds, were described in Section 4.3.2 and determined to be MODERATE. The adverse impacts are associated primarily with the permanent conversion of approximately 11.4 mi of Outer Piedmont tributaries to a reservoir (Duke 2012n).

In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable actions that could affect aquatic ecology. For this analysis, the geographic area of interest and areas most likely to show the impact of water-use and water-quality criteria for aquatic biota are the drainage basin of the Broad River from Gaston Shoals Dam downriver approximately 33 mi to Lockhart Dam just below the Broad River's junction with the Pacolet River; Make-Up Ponds A, B, and C; Hold-Up Pond A; London Creek and its tributaries; and corresponding intermittent and seasonal streams on the Lee Nuclear Station site. In addition, waterbodies crossed by the transmission-line corridors are considered within each corridor as described for terrestrial resources in Section 4.3.1, and include Abingdon Creek, Fanning Creek, Gault Creek, Gilkey Creek, the Pacolet River, Quinton Branch, Reedy Branch, Service Branch, Thicketty Creek, and numerous unnamed tributaries to those waterbodies. The corridors are included as part of the geographic area of interest because of the potential for impacts to aquatic resources. According to the Joint Permit Application submitted by Duke to the USACE, there will be no fill impacts to tributaries within the offsite transmission-line permit area components because the transmission lines will span the tributaries and the transmission structures will be located within the uplands (Duke 2011h). Other actions listed in Table 7-1 within the geographic area of interest that have present and reasonably foreseeable potential impacts on the aquatic ecological resources of the Broad River drainage basin from Gaston Shoals Dam to Lockhart Dam include operation of several hydroelectric facilities (i.e., Gaston Shoals, Cherokee Falls, Ninety-Nine Islands, and Lockhart), discharge of water by domestic and industrial NPDES permit holders, withdrawal of water for domestic and industrial purposes, use of managed parks and preserves such as the Broad Scenic River, implementation of the *Santee-Cooper Basin Diadromous Fish Passage Restoration Plan* (FWS 2001) and the *Santee River Basin Accord for Diadromous Fish Protection, Restoration, and Enhancement* (SRBA 2008), and future urbanization in the region. The evaluation of cumulative impacts on aquatic biota from these actions is described below.

Southern Power Company completed building Ninety-Nine Islands Dam in 1910 (Taylor and Braymer 1917). Parr Shoals Dam and Gaston Shoals Dam were completed in 1914 and 1927, respectively. By the 1930s, access to many miles of riverine habitat in the Broad River basin was blocked by hydroelectric dams that supplied electricity to cotton mills and to towns for lighting, power, and street railway service (Taylor and Braymer 1917). While providing many benefits to people, the dams blocked the movement of resident and diadromous fish and fragmented the river system by altering flows, bed-load movements, water chemistry, and habitats (FWS 2001). Partial building of the unfinished Cherokee Nuclear Station between 1977 and 1982 significantly changed surface-water characteristics in the vicinity of the station. McKowns Creek, impounded to create Make-Up Pond B, originally flowed down a moderate gradient through alternating pools and gravel riffles (NRC 1975a). Mean annual flow was small, estimated at 1 to 3 cfs. Phytoplankton and benthic invertebrates were diverse and abundant. Creek Chub (*Semotilus atromaculatus*) was the only fish species collected from the creek. Site runoff was impounded to create Hold-Up Pond A, while the building of an additional dam permanently separated part of the full-pond backwater area from the rest of Ninety-Nine Islands Reservoir to create Make-Up Pond A (NRC 1975a). These areas, although isolated from the river, did develop their own aquatic communities, as described in Section 2.4.2.1. Creek Chub do not survive in the ponded areas.

Building of Make-Up Pond A also affected Ninety-Nine Islands Reservoir because dam-building activities occurred directly in the waters of the reservoir (NRC 1975a). Estimates in the Cherokee Nuclear Station Final Environmental Statement indicated that up to 50 percent of the reservoir would be affected by temporary increases in turbidity from building activities (NRC 1975a). However, following building activities, the biota of affected areas in the reservoir were expected to slowly revert back to their former composition. Species checklists developed before building activities at the site compared with 2006 species survey data show the same number of species were captured in 1973 to 1974 as in 2006, although the actual species composition is somewhat different (Duke 2009c). In general, the number of cyprinid (minnow) and darter species appears to have declined, while the number of centrarchid (sunfish and bass) species has increased (Table 2-11) (Duke 2009c).

Overall, the partial building of the Cherokee Nuclear Station affected approximately 3.2 mi^2 of the McKowns Creek and the Broad River watersheds when Make-Up Ponds A and B and Hold-Up Pond A were built (Table 2-5).

The review team considered the potential cumulative impacts due to impingement and entrainment of aquatic biota. Operation of the proposed Lee Nuclear Station Units 1 and 2 would result in some losses resulting from impingement and entrainment of aquatic biota in the Broad River and in Make-Up Ponds A, B, and C. As discussed in Section 5.3.2.1, the proposed closed-cycle wet cooling system with cooling towers for the proposed Lee Nuclear Station Units 1 and 2 would not be expected to result in measurable impingement or entrainment-related impacts. In addition, most of the suitable spawning habitat for the fish species present in the Broad River in the vicinity of the Lee Nuclear Station site is in the backwater of the reservoir rather than near the proposed intake structure. Lower abundances of fish larvae were found in the vicinity of the proposed intake compared to the backwater areas, and many of the fish species' spawning habits (i.e., nest-building rather than broadcast spawning) reduce potential impacts from entrainment.

Some aquatic species are entrained through the Gaston Shoals, Cherokee Falls, Ninety-Nine Islands, and Lockhart Dams. These organisms may survive but are essentially lost to the reservoir from which they originated. For example, the hydroelectric plant at Ninety-Nine Islands Dam generates 18 MW through operation of six turbine units (Huff and Lewis 2010). A continuous minimum flow requirement of no less than 483 cfs results in the transport of aquatic biota within the influence of the turbine intake systems downriver below Ninety-Nine Islands Dam. The operation of the hydroelectric plant influences aquatic communities within Ninety-Nine Islands Reservoir by preventing organisms that pass through the hydropower facility from returning upstream of the facility.

Overall, the review team concludes that the cumulative impacts of impingement and entrainment on the fishery is minor and would not negatively affect aquatic populations, including species of special interest or Federally listed or State-ranked species.

The review team considered the potential cumulative impacts resulting from thermal discharges. Blowdown from the proposed Lee Nuclear Station Units 1 and 2 would enter the Broad River. The blowdown discharge to the Broad River, described in more detail in Section 5.3.2.1, is not likely to noticeably affect the biota, water quality outside the proposed mixing zone, or consumptive use at Ninety-Nine Islands Hydroelectric Project. Two companies within the geographical area of interest currently hold major industrial NPDES permits to discharge to the Broad River and Pacolet Rivers, respectively (Table 7-2). Four major domestic NPDES permits currently allow significant discharges to the Broad River, Pacolet River, and Thicketty Creek (Table 7-2). The Pacolet River and Thicketty Creek are tributaries to the Broad River downstream of the Lee Nuclear Station site. Should other industrial or domestic plants begin operations in the future, thermal discharges from those facilities would be regulated by the State. Currently, the SCDHEC requires that Broad River water temperatures not increase more than 5°F above ambient river temperatures and that river temperatures not exceed 90°F as a result of heated water discharge, with the exception of a defined mixing zone, which would require approval by the SCDHEC (2008a). Duke submitted an NPDES permit application to the SCDHEC that included a mixing zone request (Duke 2011a). SCDHEC issued the NPDES permit (Permit No. SC0049140) on July 17, 2013, effective September 1, 2013 (SCDHEC 2013a). As discussed in Section 5.3.2.1, the NPDES permit requires Duke to submit for SCDHEC's approval a plan for confirmatory monitoring.

Table 7-2. Major NPDES Permit Holders Discharging to Waters in the Aquatic Geographic Area of Interest (SCDHEC 2007b)

NPDES Permit	Facility Name	Receiving Water	Permitted Flow at Pipe (Mgd)
SC0003182, Industrial	Milliken & Co./Magnolia PLT	Broad River	3.89
SC0047091, Domestic	City of Gaffney/Peoples Creek PLT	Broad River	4.0
SC0031551, Domestic	City of Gaffney/Clary Waste Water Treatment Plant	Thicketty Creek	5.0
SC0002798, Industrial	Invista SARL/Spartanburg	Pacolet River	Volume discharge not specified in permit; Monitor and Report
SC0045624, Domestic	Spartanburg Sanitary Sewer District/ Town of Cowpens/Pacolet River	Pacolet River	1.5
SC0020435, Domestic	Spartanburg Sanitary Sewer District/ Fairforest Regional Waste Water Treatment Facility	Pacolet River	19.0

The review team conservatively estimated the maximum fraction of the Broad River that could achieve a 5°F temperature increase (typically used to define the extent of a thermal plume) during a warm summer period (monthly mean temperature of 86°F). Under normal discharge conditions (18 cfs), the review team estimated that no more than 11 percent of the flow could sustain a temperature increase of 5°F. However, under maximum discharge conditions (64 cfs), the review team estimated that no more than 34 percent of the flow could sustain a temperature increase of 5°F. In either scenario, motile species such as fish would be able to find adequate refuge from the heated water discharge. The review team's independent analysis determined the increase in ambient water temperatures would not adversely affect aquatic organisms in the river, including Smallmouth Bass (*Micropterus dolomieu)* (Section 5.3.2.1).

Thus, the review team considers the cumulative impacts from thermal discharges would be minor and would not negatively impact aquatic organisms, including species of special interest or Federally listed or State-ranked species.

The review team also considered the potential cumulative impacts from chemical releases. Duke's Catawba Nuclear Station uses similar chemicals as those proposed for the Lee Nuclear Station. The Catawba Nuclear Station, located on the Catawba River in South Carolina, is in compliance with NPDES permit requirements. The Lee Nuclear Station must be able to meet chemical discharge criteria set by the SCDHEC in its NPDES Permit, issued July 17, 2013 (SCDHEC 2013a). In addition, Broad River water quality may be affected by discharges from other plants or facilities in the geographical region of interest, such as the major permit holders listed in Table 7-2 and at least 37 other existing minor NPDES permit holders in the Broad River basin currently discharging to the Broad River and its numerous tributaries (i.e., Bells Branch tributary, Buffalo Creek and a tributary, Cherokee Creek, Irene Creek, Island Creek, Jones Creek, Kings Creek and a tributary, Little Buck Creek, Little Cherokee Creek, Long Branch, Manning Branch, Mill Creek and a tributary, the Pacolet River and tributaries, Peoples Creek, Peters Creek and a tributary, Providence Branch, Spencer Branch and a tributary, and Thicketty Creek). The SCDHEC, which grants NPDES permits in South Carolina, took cumulative chemical releases from the proposed Lee Nuclear Station Units 1 and 2 and from other domestic and industrial sites discharging to the Broad River and its tributaries into consideration before approving its NPDES permit for the proposed units (Permit No. SC0049140, issued July 17, 2013). Therefore, the cumulative effects from the existing NPDES permit holders and the proposed Lee Nuclear Station Units 1 and 2 are not expected to negatively affect aquatic organisms, including species of special interest or Federally listed or State-ranked species, and are considered to be minor.

The review team considered the potential cumulative impacts resulting from surface-water withdrawals. Duke estimates that water withdrawal rates for the proposed Lee Nuclear Station would vary between 78 cfs (normal operations) and 134 cfs (maximum-use operations) from March through June and up to 304 cfs (maximum-use operations) between July and February when water could be withdrawn for station operation and makeup pond refill (Duke 2009c, 2011a). Within the geographic area of interest, one large community water system currently withdraws surface water from the Broad River. The Gaffney Board of Public Works has an 18 Mgd treatment capacity (GBPW 2010). Other community water systems in the geographical region of interest purchase water from other entities or obtain groundwater from wells. Many communities have above-ground and ground-level water storage to mitigate water needs during low water conditions. On January 1, 2011, Act No. 247, which amended the "South Carolina Surface Water Withdrawal and Reporting Act", went into effect. The Act was renamed the

"South Carolina Surface Water Withdrawal, Permitting, Use, and Reporting Act," and provides that, subject to certain exemptions, surface-water withdrawals must be made pursuant to a permit issued by the SCDHEC (SC Code Ann. 49-4). This new permitting process should ensure that future water withdrawals from the Broad River basin will not compromise aquatic uses or resources in South Carolina. The Broad River basin extends into North Carolina. While a permitting process for surface-water withdrawal does not yet exist in North Carolina (the Water Resource Policy Act of 2009 [NCGA 2009] has been brought before the General Assembly but has not passed), the North Carolina Department of Environment and Natural Resources (NCDENR) does require surface and groundwater withdrawers who meet conditions established by the General Assembly to register their water withdrawals and surface-water transfers with the State and to report their water usage annually (NCDENR 2011a). A proposal for a 1200-ac water-storage reservoir on the First Broad River in North Carolina by the Cleveland County Water Board is outside the regional area of interest, but is an example of another demand on Broad River water resources that will have to be considered by the SCDHEC.

The review team considered the potential cumulative impacts resulting from maintenance dredging activities at the Lee Nuclear Station site, including Make-Up Pond A and the Broad River intake and discharge structures. Periodic dredging would be required at the Broad River intake structure (Duke 2008o, 2012b). These events would impact a relatively small area and would be short term in duration. As such, impacts would be localized and temporary, and benthic macroinvertebrates would likely recolonize the area quickly. Maintenance dredging at the Broad River discharge site is not expected (Duke 2008p). Periodic dredging of Make-Up Pond A may be required (Duke 2009b). The soft-sediment environment would help to speed recovery from the effects of dredging in the pond. All maintenance dredging activities would be performed in accordance with SCDHEC and USACE permit conditions, and Duke has committed to using best management practices (BMPs) while performing dredge operations, thereby mitigating potential impacts. Because Make-Up Ponds B and C would receive water only during refill operations (i.e., to replenish water levels due to loss from evaporation or from use during low-flow periods), sedimentation rates are expected to be variable, but slow, and maintenance dredging would not be required (Duke 2009b).

The review team considered diadromous fish species potentially available in the future. The *Santee-Cooper Basin Diadromous Fish Passage Restoration Plan* (Plan) (FWS 2001) and the *Santee River Basin Accord for Diadromous Fish Protection, Restoration, and Enhancement* (Accord) (SRBA 2008) focus on restoring habitat connectivity for diadromous fish that were historically present within the basin. Within the Santee-Cooper basin, the Plan identified the Broad River sub-basin as a high priority for restoration because of the amount of potential habitat available as well as the quality of existing habitat. There is currently no evidence that the Plan's targeted diadromous fish species reside within the vicinity of the Lee Nuclear Station site; but there are documented historical accounts that some species (e.g., American Eel

[*Anguilla rostrata*] and American Shad [*Alosa sapidissima*]) migrated to the upper reaches of the Broad River. Future restoration efforts may result in the reestablishment of migratory fish populations upstream of Ninety-Nine Islands Dam. Potential impacts on aquatic biota resulting from the operation of the proposed Lee Nuclear Station Units 1 and 2 are evaluated in Section 5.3.2. With respect to future populations of migratory fish that may become established in the Broad River, impacts stemming from impingement and entrainment are likely to be minimal because of the use of closed-cycle cooling, the low through-screen velocity (less than 0.5 fps), the limited hydraulic zone of influence, and the location and design of the intake structure, including dual-flow vertical traveling screens with fish return system. The discharge effluent may result in localized thermal, chemical, and physical impacts; however, as discussed in Section 5.3.2.1, impacts on populations of aquatic biota, including diadromous fish species, would likely be minimal. In a letter to National Marine Fisheries Service (NMFS) dated August 14, 2012, the NRC concluded its consultation with the NMFS under the Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, and Fish and Wildlife Coordination Act for the Lee Nuclear Station COL application. In the event of successful implementation of the fish passage program as described in the Accord, the NRC staff will consider potential thermal, chemical, and physical impacts to Federally protected species from operations at the Lee Nuclear Station (NRC 2012d).

As previously discussed in Section 2.4.2.3, the FWS indicated that one listed mussel species, the Carolina Heelsplitter (*Lasmigona decorata*), was known to be present in York County, which bounds the Broad River downstream of Ninety-Nine Islands Dam (Table 2-13). However, the review team reviewed the literature and species summaries and found no evidence there are likely to be any Federally listed aquatic species in the vicinity of the Lee Nuclear Station site or in any waterbodies crossed by the transmission-line corridors (FWS 2010c). Further, there are no areas designated by the FWS as critical habitat for Federally listed threatened and endangered species in the vicinity of the Lee Nuclear Station site or the new transmission-line corridors (FWS 2008a). One South Carolina State-ranked fish species, the Carolina Fantail Darter (*Etheostoma brevispinum*) (Table 2-13), and recreational fisheries for sunfish, crappie, and bass (centrarchids); catfish (ictalurids); and suckers (catostomids) occur in the Broad River in the vicinity of Lee Nuclear Station. In addition, some aquatic taxa encountered near the proposed site have been identified as State conservation priority species. Five fish species listed as highest or high priority species by the SCDNR (2005) were found during surveys conducted by Duke or the SCDNR in the Broad River in the vicinity of the proposed new nuclear station, in London Creek, or in tributaries to the Broad River that may be crossed by new transmission-line corridors associated with the proposed Lee Nuclear Station. The five species are (1) Highfin Carpsucker (*Carpiodes velifer*), (2) Quillback (*C. cyprinus*), (3) Seagreen Darter (*Etheostoma thalassinum*), (4) Greenhead Shiner (*Notropis chlorocephalus*), and (5) Piedmont Darter (*Percina crassa*). Site-preparation and installation activities at Lee Nuclear Station site waterbodies, adjacent portions of the Broad River, London Creek and its tributaries, Broad River tributaries crossed by the new transmission-line corridors, and the new culvert under the existing railroad spur would use BMPs associated with water quality (developed by Duke and accepted or modified by State and Federal agencies through the permitting process). Therefore, the impact to State-ranked, recreational, and State conservation priority species would be short-term and minimal. Similarly, BMPs and environmentally responsible practices would be followed during maintenance activities at the Lee Nuclear Station site, Make-Up Pond C, railroad-spur corridor, and transmission-line corridors.

Cumulative impacts on aquatic resources within Ninety-Nine Islands Reservoir and Make-Up Ponds A, B, and C may also include activities or events that are distinct from the Lee Nuclear Station site. Anthropogenic activities such as residential or industrial developments near the vicinity of the nuclear facility can present additional constraints on aquatic resources. Future activities may include shoreline development (i.e., removal of habitat), increased water needs for domestic and industrial purposes, increased discharge of effluents into the Broad River, and increased recreational use of the river. Although the potential for long-term development in this area exists, its interactions with plant operations are not expected to result in significant adverse impacts to the river in the vicinity of Lee Nuclear Station. In fact, the Broad River below Ninety-Nine Islands Dam to the confluence of the Pacolet River is designated as a scenic river. A voluntary, cooperative community-based process is used by the SCDNR, landowners, and other community interests to accomplish river conservation goals (SCDNR 2006a).

In addition to direct anthropogenic activities, physical disturbances and climatic events may impose external stressors on aquatic communities. Aquatic ecosystem responses to these events are difficult to predict. At certain times of the year, operation of Lee Nuclear Station, other anthropogenic stressors, and climatic events could combine to adversely affect the aquatic populations of Ninety-Nine Islands Reservoir and Make-Up Ponds A, B, and C. The level of impact resulting from these activities or events would depend on the intensity of the perturbation and the resiliency of the aquatic communities.

During drought periods, Duke will be required to manage water withdrawals from the river to maintain adequate downstream flow and meet the Ninety-Nine Islands Federal Energy Regulatory Commission (FERC) license continuous minimum release requirements. This is important to ensure that adequate habitat and water-quality conditions are provided for both aquatic organisms and downstream users. When water flow in the Broad River falls below 538 cfs (FERC minimum release of 483 cfs plus Lee Nuclear Station average consumptive use of 55 cfs), Duke has committed to use water stored in Make-Up Ponds B and C as cooling water for the condensers to maintain the necessary water flows in the Broad River (Duke 2009b).

7.3.2.1 Summary of Aquatic Ecology Impacts

Cumulative impacts on aquatic ecology from construction, preconstruction, and operation of the proposed Lee Nuclear Station and other past, present, and reasonably foreseeable projects are estimated based on the information provided by Duke, the FWS, the SCDNR, and the review team's independent evaluation. Based on the findings discussed above, with emphasis on the impacts associated with creation of Make-Up Pond C, the review team concludes that cumulative impacts on aquatic biota related to proposed Lee Nuclear Station Units 1 and 2 would be MODERATE. The loss of a major portion of London Creek and its aquatic biota during development of Make-Up Pond C is the principal contributor to the cumulative impact. Development of Make-Up Pond C does not require NRC authorization; incremental impacts from NRC-authorized activities (which are limited to the Lee Nuclear Station site) do not significantly contribute to the cumulative impact to the aquatic ecology of the geographic region of interest.

7.4 Socioeconomics and Environmental Justice Impacts

The evaluation of cumulative impacts on socioeconomics and environmental justice is described in the following sections.

7.4.1 Socioeconomics

The description of the affected environment in Section 2.5 serves as the baseline for the cumulative impact assessment in this resource area. As described in Section 4.4, any negative impacts of the NRC-authorized construction on socioeconomics would be SMALL, and no further mitigation would be warranted with two exceptions in Cherokee County. NRC-authorized construction would result in a MODERATE and adverse impact on infrastructure and community services because of traffic on roads near the site (particularly on McKowns Mountain Road) and a MODERATE physical impact because of aesthetics. As described in Section 5.4, any negative impacts of operations on socioeconomics would be SMALL, and no further mitigation would be warranted beyond that which was identified by the applicant. The review team concluded that operations would result in LARGE beneficial economic impacts because of tax revenue in Cherokee County and SMALL beneficial economic and tax revenue impacts elsewhere in the region.

The combined impacts from building proposed Lee Nuclear Station Units 1 and 2, new transmission corridors, and Make-Up Pond C were described in Section 4.4 and determined to be SMALL and adverse with two exceptions. The review team determined that an impact on infrastructure and community services because of traffic and a physical impact on aesthetics in the vicinity of the site would be MODERATE. In addition to the impacts from preconstruction, construction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future projects that could impact socioeconomics. For this analysis, the geographic area of interest is considered to be Cherokee and York Counties because these counties are the principal areas where the review team expects socioeconomics impacts would occur. However, the geographic area of interest was modified as appropriate for specific impact analyses; for example, taxation jurisdictions were used when appropriate.

In the early 1970s, Duke started construction of the Cherokee Nuclear Station. Construction was halted on the three unit facility in the early 1980s due to financial reasons. The unfinished plant was converted into a movie set in the late 1980s and then left idle for about two decades. Historically, Cherokee and York Counties were rural communities with significant employment in textile mills. However, recently these counties have shifted away from textiles and both, particularly York County, have become more suburban.

The socioeconomic impact analyses in Chapters 4 and 5 are cumulative by nature. Economic impacts associated with activities listed in Table 7-1 already have been considered as part of the socioeconomic baseline presented in Section 2.5. For example, the economic impacts of existing enterprises (e.g., mining and other electrical utilities) are part of the base used for establishing the Regional Input-Output Modeling System (RIMS II) multipliers. Regional planning efforts and associated demographic projections formed the basis for the review team’s assessment of reasonably foreseeable future impacts. Thus, no cumulative impacts are associated with building and operating the Lee Nuclear Station beyond those already evaluated in Chapters 4 and 5.

Based on the above considerations, Duke’s ER, and the review team's independent evaluation, the review team concludes that cumulative impacts from preconstruction, construction, and operation of proposed Lee Nuclear Station Units 1 and 2 and from other past, present, and future projects within the geographic area of interest could make a temporary adverse contribution to the cumulative effects associated with some socioeconomic issues. Those impacts would include physical impacts (i.e., workers and the local public, buildings, transportation, and visual aesthetics), demography, and local infrastructure and community services (i.e., traffic, recreation, housing, public services, and education).

The review team concludes that the cumulative economic impacts on regional economies and tax revenues would be beneficial and SMALL with the exception of Cherokee County, which would see a LARGE and beneficial cumulative economic impact on taxes. The NRC-authorized activities would be a significant contributor to the LARGE and beneficial economic impact on taxes in Cherokee County.

The review team concludes that the cumulative infrastructure and community impacts are SMALL with the exception of a MODERATE and adverse cumulative impact related to traffic near the Lee Nuclear Station site (particularly on McKowns Mountain Road). The NRC-authorized activities would be a significant contributor to the MODERATE and adverse impact on infrastructure and community services related to traffic near the site.

The review team concludes that the cumulative physical impacts are SMALL with the exception of a MODERATE and adverse cumulative impact on aesthetics near the site. Construction of transmission-line corridors and Make-Up Pond C do not require NRC authorization; therefore, the NRC staff concludes that the incremental impacts from NRC-authorized activities for the proposed plant, which are limited to the Lee Nuclear Station site, Make-Up Pond C site, and transmission-line corridors, would not be a significant contributor to the MODERATE physical impact on aesthetics.

The review team concludes that building the proposed Lee Nuclear Station in addition to other past, present, and reasonably foreseeable future projects would have SMALL cumulative impacts on demography.

7.4.2 Environmental Justice

The description of the affected environment in Section 2.6 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.5, the NRC staff concludes that the NRC-authorized construction would impose no disproportionately high and adverse impacts on minority or low-income populations and, therefore, the environmental justice impacts would be SMALL. As described in Section 5.5, the review team concludes that the impacts of operations on environmental justice would be SMALL, and no mitigation would be warranted.

The combined environmental justice impacts from building were described in Section 4.5 and determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future projects that could cause disproportionately high and adverse impacts on minority and low-income populations. For this cumulative analysis, the geographic area of interest is considered to be the 50-mi region described in Section 2.5.1.

From an environmental justice perspective, the potential exists for minority and low-income populations to experience disproportionately high and adverse impacts from large industrial projects. As discussed in Section 2.6.1, the review team found low-income, black, Asian, American Indian or Alaskan Native, Hispanic, and aggregated minority populations of interest. However, most of these populations were either located in cities and towns or near the edge of the 50-mi region and not near the proposed Lee Nuclear Station site. The nearest minority population of interest was found in the town of Gaffney in Cherokee County. The nearest low-income population of interest was in York County. As discussed in Sections 2.6, 4.5, and 5.5, the review team found no unique characteristics or practices through which minority or low-income populations would experience a disproportionately high and adverse impact from building or operating proposed Lee Nuclear Station Units 1 and 2.

The environmental justice impact analyses in Chapters 4 and 5 are cumulative by nature. Environmental justice impacts associated with activities listed in Table 7-1 already have been considered as part of the environmental justice baseline presented in Sections 2.6 and 7.4.1. Based on the above considerations, information provided by Duke, and the review team's independent evaluation, the review team concludes that building and operating proposed

Lee Nuclear Station Units 1 and 2 would not contribute additional environmental justice cumulative impacts beyond those described in Chapters 4 and 5. As discussed in Section 2.6.1, factors that went into the review teams determination included an assessment of the unique characteristics and practices of minority and low-income populations of interest with regard to the following socioeconomic impact areas: physical impacts (i.e., workers and the local public, noise, air quality, buildings, transportation, and visual aesthetics), and local infrastructures and community services (i.e., transportation; recreation; housing; water and wastewater facilities; police, fire, and medical services; social services; and schools).

The review team concludes there would be no disproportionately high and adverse cumulative impacts to minority or low-income populations from the above socioeconomic impact areas. The environmental justice impacts would be SMALL, and no further mitigation beyond that described in Chapters 4 and 5 would be warranted.

7.5 Historic and Cultural Resources Impacts

The description of the affected environment in Section 2.7 serves as a baseline for the cumulative impacts assessment in this resource area. The cultural resources management plan and associated Memorandum of Agreement (MOA) between Duke, the USACE, the South Carolina State Historic Preservation Officer (SHPO), and the Catawba Indian Nation Tribal Historic Preservation Officer (THPO) formalizing ongoing cultural resources protection and consideration at the Lee Nuclear Station site and associated developments (USACE et al. 2013) are also important elements for the cumulative impacts assessment.

As described in Section 4.6, for the purposes of NEPA analysis and consultation under Section 106 of the National Historic Preservation Act (NHPA), the NRC staff reviewed the final cultural resources management plan and MOA (USACE et al. 2013), cultural resources survey reports, NRC and USACE consultation records, Duke's past and ongoing record of coordination with the South Carolina SHPO and American Indian Tribes that have expressed interest in the proposed undertaking, and Duke Energy's corporate policy for cultural resources consideration and protection (Duke 2009j). The NRC staff concludes that the impacts of NRC-authorized construction on historic and cultural resources would likely be SMALL and no further mitigation would be warranted. As described in Section 5.6, the review team concludes that the impacts of operations on historic and cultural resources would likely be SMALL. Mitigative actions may be warranted only in the event of an unanticipated discovery during ground-disturbing activities associated with construction or maintenance of the operating facility. Procedures for addressing discoveries of this nature, including work stoppage and coordination with the South Carolina SHPO and appropriate THPOs, are an important part of Duke Energy's corporate cultural resources policy and are specifically tailored to the proposed Lee Nuclear Station site and associated developments in the cultural resources management plan and associated MOA between Duke, the USACE, the South Carolina SHPO, and the Catawba Indian Nation THPO (USACE et al. 2013).

Cumulative Impacts

The combined impacts from construction and preconstruction are described in Section 4.6 and are concluded to be MODERATE for preconstruction of Make-Up Pond C and offsite developments, including the railroad line, two new transmission lines (Routes K and O), and transportation improvements at six key intersections. Mitigative actions associated with the future removal and relocation of the historic Service Family Cemetery, a locally important cultural resource, from Make-Up Pond C and avoidance and protection of a possible human burial site (38CK172) located in the direct, physical Area of Potential Effect (APE) for transmission-line Route O will be completed by Duke (Duke 2010d, o). The cultural resources management plan and associated MOA between Duke, the USACE, the South Carolina SHPO, and the Catawba Indian Nation THPO (USACE et al. 2013) formally accepts and implements Duke Energy's corporate policy for cultural resources protection and inadvertent discovery procedures.

In addition to the combined impacts from construction, preconstruction, and operations, cumulative impact analyses consider other past, present, and reasonably foreseeable future actions that could impact historic and cultural resources in the defined geographic area of interest. For this cumulative analysis, the geographic area of interest corresponds to the direct and indirect APEs that encompass physical and visual impacts reasonably determined to occur during construction, preconstruction, and operation of proposed Lee Nuclear Station Units 1 and 2; development and operation of Make-Up Pond C; and development, operation, and maintenance of associated offsite developments including the railroad line, two new transmission lines, and six intersections proposed for transportation improvements. These APEs have been defined by Duke in coordination with the South Carolina SHPO and are described in Section 2.7.

The cumulative impacts assessment considers all historic and cultural resources within the geographic area of interest, including those eligible for listing on the National Register of Historic Places (National Register), which are also known as historic properties. Potentially, this could include prehistoric archaeological sites representing as many as 12,000 years of human occupation, architectural sites representing important regional historic contexts (e.g., eighteenth- and nineteenth-century farmsteads, nineteenth-century ironworks, and twentieth-century hydroelectric plants), or sites of importance to local communities or American Indian tribes (e.g., historic cemeteries, burial sites, and traditional cultural properties). As residential areas, roads, utilities, and businesses have generally increased in the region over the past few decades, historic and cultural resources have probably decreased. One past project, partial development of the unfinished Cherokee Nuclear Station (Table 7-1), impacted six historic and cultural resources within the geographic area of interest. As described in Sections 4.6 and 5.6, the six historic and cultural resources impacted by intensive ground disturbance during this project in the 1970s were not considered to be significant by the cultural resources specialists who recorded them and it is unlikely that any were eligible for National Register nomination.

Table 7-1 identifies other past, present, and reasonably foreseeable future projects and other actions considered in the cumulative analyses for proposed Lee Nuclear Station Units 1 and 2.

Present projects within the geographic area of interest for historic and cultural resources include operational hydroelectric plants on the Broad River. One of these facilities, Ninety-Nine Islands Dam and Hydroelectric Project, is historically significant and eligible for National Register listing. These projects could have minimally impacted historic and cultural resources through ground disturbance, but any potential adverse effects would have likely been addressed through environmental review and associated NHPA and NEPA compliance during Federal licensing or relicensing by FERC. Table 7-1 also identifies small-scale surface mining projects (i.e., sand, clay, other mineral products, and construction materials), the Gaffney Wastewater Treatment Facility, and the SC Distributors Inc. fabric mill currently in operation within the geographic area of interest (indirect APE for Make-Up Pond C). These projects could have caused minimal impacts to archaeological resources through ground-disturbing activities or visual impacts to architectural resources if new above-ground structures have altered the historic setting or visual characteristics that make these properties significant. However, adverse impacts are unlikely as no National Register-eligible historic properties have been identified in the geographic area of interest during architectural surveys for the Lee Nuclear Station site and associated developments (Brockington 2007a, b, 2009a, 2013) or Make-Up Pond C and associated developments (Brockington 2009b, 2010, 2011, 2013).

Future projects listed in Table 7-1 within the geographic area of interest include transportation improvement projects throughout South Carolina and in Cherokee County. These projects could impact historic and cultural resources through ground disturbance or visual impacts to historic settings or architectural properties. However, since these projects would likely include Federal funding, impacts would be analyzed through Federal agency compliance with NHPA and NEPA, and it is unlikely that adverse effects to historic properties or important cultural resources would occur.

Historic and cultural resources are nonrenewable; therefore, the impact of their destruction is cumulative. For the purposes of the review team's NEPA analysis, based on the information provided by the applicant and the review team's independent evaluation, the review team concludes that the cumulative impacts from preconstruction, construction, and operation of proposed Lee Nuclear Station Units 1 and 2 and from other past, present, and future projects within the geographic area of interest would be MODERATE. The incremental impacts associated with the past destruction of unassessed archaeological resources during preparations for the unfinished Cherokee Nuclear Station in the 1970s and currently proposed preconstruction activities, including removal and relocation of the Service Family Cemetery from the direct, physical APE for Make-Up Pond C and project avoidance of a possible human burial site (38CK172) in the direct, physical APE for transmission Route O, are the principal contributors to the MODERATE rating of cumulative impacts. The NRC staff further concludes that the incremental impacts associated with the NRC-authorized activities would not significantly contribute to the cumulative impact because no significant historic or cultural resources would be affected by these activities in the geographic region of interest.

7.6 Air-Quality Impacts

The description of the affected environment in Section 2.9 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.7, the NRC staff concludes that the impacts of NRC-authorized construction on air quality would be SMALL, and no further mitigation would be warranted. As described in Section 5.7, the review team concludes that the impacts on air quality from operations would be SMALL, and no further mitigation would be warranted.

7.6.1 Criteria Pollutants

The combined impacts from construction and preconstruction were described in Section 4.7 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts on air quality. The geographic area of interest defined for this evaluation is Cherokee County, South Carolina. The single county was selected because EPA air quality designations are made on a county-by-county basis.

Cherokee County is designated as unclassifiable or in attainment for all criteria pollutants for which National Ambient Air Quality Standards (NAAQS) have been established (40 CFR 81.341). Criteria pollutants include ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead. Emissions from building proposed Lee Nuclear Station Units 1 and 2 are expected to be temporary and limited in magnitude, as described in Section 4.7. As described in Section 5.7, air emissions from operations would be primarily from the intermittent use of standby diesel generators and pumps. Table 5-4 provides estimates of annual air emissions from these sources; these sources would be permitted and operated in accordance with State regulatory requirements (Duke 2009c).

There are eight major sources of air emissions in Cherokee County with existing Title V operating permits (EPA 2013a). There are no new major sources proposed for Cherokee County (EPA 2013b). The existing sources include energy and industrial projects and are listed in Table 7-1. Future development of the region around the Lee Nuclear Station site could also lead to increases in gaseous emissions related to transportation. Table 7-1 lists low-to-moderate potential for growth within Cherokee County.

Given that Cherokee County is currently designated unclassifiable or in attainment for existing sources identified in Table 7-1 and the expected low-to-moderate potential for growth in the county, the review team concludes that the cumulative impacts on air quality from the additional air emissions from intermittent operation of diesel generators at the Lee Nuclear Station site would be minimal, and mitigation would not be warranted.

7.6.2 Greenhouse Gas Emissions

As discussed in the state of the science report issued by the U.S. Global Change Research Program (GCRP), it is the "… production and use of energy that is the primary cause of global warming, and in turn, climate change will eventually affect our production and use of energy. The vast majority of U.S. greenhouse gas emissions, about 87 percent, come from energy production and use…" Approximately one-third of the greenhouse gas (GHG) emissions are the result of generating electricity and heat (GCRP 2009).

GHG emissions associated with building, operating, and decommissioning a nuclear power plant are addressed in Sections 4.7, 5.7, 6.1.3, and 6.3. The review team concluded that the atmospheric impacts of the emissions associated with each aspect of building, operating, and decommissioning a single plant are minimal. The review team also concluded that the impacts of the combined emissions for the full plant life cycle would be minimal.

It is difficult to evaluate cumulative impacts of a single source or combination of GHG emission sources because:

- the impact is global rather than local or regional
- the impact is not particularly sensitive to the location of the release point
- the magnitude of individual GHG sources related to human activity, no matter how large compared to other sources, are small when compared to the total mass of GHGs in the atmosphere
- the total number and variety of GHG emission sources are extremely large and are ubiquitous

These points are illustrated by the following comparison of annual carbon dioxide (CO_2) emission rates (Table 7-3).

Table 7-3. Comparison of Annual CO_2 Emission Rates

Source	Metric Tons per Year
Global emissions	30,000,000,000[(a)]
United States	5,500,000,000[(a)]
1000-MW nuclear power plant (including fuel cycle, 80 percent capacity factor)	500,000[(b)]
1000-MW nuclear power plant (operations only)	5000[(b)]
Average U.S. passenger vehicle	5[(c)]

(a) EPA 2011c
(b) Appendix J of this EIS
(c) EPA 2010ac

Evaluation of cumulative impacts of GHG emissions requires the use of a global climate model. The GCRP (2009) report referenced above provides a synthesis of the results of numerous climate modeling studies. The review team concludes that the cumulative impacts of GHG emissions around the world as presented in the report are the appropriate basis for its evaluation of cumulative impacts. Based on the impacts set forth in the GCRP (2009) report and the CO_2 emissions criteria in the final EPA CO_2 Tailoring Rule (75 FR 31514), the review team concludes that the national and worldwide cumulative impacts of GHG emissions are noticeable but not destabilizing. The review team further concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the GHG emission of the proposed project.

Consequently, the review team recognizes that GHG emissions, including CO_2, from individual stationary sources and, cumulatively from multiple sources, can contribute to climate change and that the carbon footprint is a relevant factor in evaluating energy alternatives. Section 9.2.5 contains a comparison of carbon footprints of the viable energy alternatives.

7.6.3 Summary of Air-Quality Impacts

Cumulative impacts on air-quality resources are estimated based on the information provided by Duke and the review team's independent evaluation. Other past, present, and reasonably foreseeable future activities exist in the geographic areas of interest (local for criteria pollutants and global for GHG emissions) that could affect air-quality resources. The cumulative impacts on criteria pollutants from air emissions from the Lee Nuclear Station site and other projects would be minimal. The national and worldwide cumulative impacts of GHG emissions are noticeable but not destabilizing. The review team concludes that the cumulative impacts would be noticeable but not destabilizing, with or without the GHG emissions from the Lee Nuclear Station site. The review team concludes that cumulative impacts from other past, present, and reasonably foreseeable future actions on air-quality resources in the geographic areas of interest would be SMALL for criteria pollutants and MODERATE for GHGs. The incremental contribution of impacts on air-quality resources from building and operating proposed Lee Nuclear Station Units 1 and 2 do not significantly contribute to the MODERATE air-quality impact from GHGs.

7.7 Nonradiological Health Impacts

The description of the affected environment in Section 2.10 serves as a baseline for the nonradiological health cumulative impact assessment. As described in Section 4.8, the NRC staff concludes that the impacts from NRC-authorized construction on public and worker nonradiological health would be SMALL, and no further mitigation other than that described in Duke's ER (Duke 2009c) would be warranted. As described in Section 5.8, the review team concludes that the impacts of operations on nonradiological health would also be SMALL, and no further mitigation would be warranted.

As described in Section 4.8, the combined nonradiological health impacts from construction and preconstruction would be SMALL, and no further mitigation would be warranted beyond what is described in Duke's ER. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative impacts to nonradiological health (see Table 7-1). Based on the localized nature of nonradiological health impacts, the geographic area of interest for this cumulative impacts analysis includes projects adjacent to the Lee Nuclear Station site and Make-Up Pond C vicinity. For cumulative impacts associated with transmission lines, the geographic area of interest is the transmission system associated with proposed Lee Nuclear Station Units 1 and 2, as described in Section 2.2.3.1.

Current operational projects within the geographic areas of interest that could contribute to cumulative impacts on nonradiological health include the Broad River Energy Center; the Cherokee County Cogeneration plant; Nine-Nine Islands Hydroelectric Project; withdrawals of surface water from the Broad River by Gaffney, South Carolina, and Shelby and Kings Mountain, North Carolina; and the Hanson Brick Blacksburg plant. One past project—partial construction of the Cherokee Nuclear Station—could contribute to cumulative nonradiological health impacts. Reasonably foreseeable projects that could contribute to cumulative nonradiological health impacts include future urbanization, highway improvements and development stemming from the South Carolina Strategic Corridor and System Plan, and American Reinvestment and Recovery Act of 2009 (ARRA) grants to the South Carolina Department of Transportation.

Preconstruction, construction, and operation activities with the potential to impact nonradiological health of the public and workers include exposure to fugitive dust and vehicle emissions, occupational injuries, noise from building and operating proposed Lee Nuclear Station Units 1 and 2, exposure to etiological (disease-causing) agents, exposure to electromagnetic fields (EMFs), and transportation of construction materials and personnel to and from the Lee Nuclear Station site.

Past partial development of the Cherokee Nuclear Station could contribute to cumulative occupational injuries for workers (i.e., slips, trips, and falls caused by remaining remnants of Cherokee Nuclear Station and associated excavations); however, adherence to Occupational Health and Safety Administration and State safety standards, practices, and procedures while onsite would help minimize these occurrences. Existing and potential development of new transmission lines could increase nonradiological health impacts from exposure to acute EMFs. However, as stated in Section 5.8.3, adherence to Federal criteria and State utility codes would create minimal cumulative nonradiological health impacts. With regard to chronic effects of EMFs, the scientific evidence on human health does not conclusively link extremely low frequency EMFs to adverse health impacts. Noise, along with emissions from operation and vehicles associated with currently operational projects (e.g., Broad River Energy Center, Cherokee County Cogeneration, and Ninety-Nine Islands Hydroelectric Project), and future projects (i.e., highway development and improvement and general future urbanization) could cumulatively contribute to public nonradiological health impacts. However, as discussed in Sections 4.8 and 5.8, the contribution of proposed Lee Nuclear Station Units 1 and 2 to these impacts would be temporary and minimal, and existing facilities and future development would likely comply with local, State, and Federal regulations governing noise and air emissions. Section 7.11.2 discusses cumulative nonradiological health impacts related to additional traffic on the regional and local highway networks leading to and from the Lee Nuclear Station site, and the review team determines that these impacts would be minimal.

In Section 5.8.1, the review team evaluated the health impacts of operating proposed Lee Nuclear Station Units 1 and 2 with regard to ambient temperature and flow conditions in the Broad River, and the potential formation of thermophilic microorganisms, including those that can cause disease (i.e., etiological agents). The review team's evaluation concluded that due to thermal mixing, operation of proposed Lee Nuclear Station Units 1 and 2 would not significantly increase the presence of etiological agents in the Broad River. Future withdrawals of surface water from the Broad River upstream of the Lee Nuclear Station site by the cities of Gaffney, South Carolina and Shelby and Kings Mountain, North Carolina, could impact the flow regime of the Broad River (i.e., decrease flow) and potentially increase the presence of etiological agents. However, as discussed in Section 2.10.1.3, the low incidence of waterborne diseases in the geographic area of interest, and South Carolina as a whole, indicates that the public uses these waters for recreation in a manner that minimizes potential exposure to these organisms.

The review team is also aware of the potential climate changes that could affect human health; a recent compilation of the state of the knowledge in this area (GCRP 2009) has been considered in the preparation of this EIS. As discussed in Section 7.2, projected climate changes for the southeastern region of the United States during the life of proposed Lee Nuclear Station Units 1 and 2 (40 years) include an increase in average temperature of 2 to 3°F; a decrease in precipitation in the winter, spring, and summer; and a small increase in precipitation in the fall (GCRP 2009). This may result in a gradual, small increase in river water temperature, which may alter the presence of microorganisms and parasites in the Broad River (i.e., warmer water may encourage the growth of thermophilic organisms). While the changes attributed to climate change in these studies (GCRP 2009) may not be insignificant on a national or global level, the review team did not identify anything that would alter its conclusion regarding cumulative impact contributing to the presence of etiological agents or a change in the incidence of waterborne diseases.

Cumulative impacts on nonradiological health are based on information provided by Duke and the review team's independent evaluation of impacts resulting from building and operation of proposed Lee Nuclear Station Units 1 and 2, along with a review of potential impacts from other past, present, and reasonably foreseeable projects and future urbanization located in the geographic areas of interest. The review team concludes that cumulative impacts on public and worker nonradiological health would be SMALL, and that mitigation beyond that discussed in Sections 4.8 and 5.8 would not be warranted. The review team acknowledges, however, that there is still uncertainty associated with chronic effects of EMFs.

7.8 Radiological Impacts of Normal Operation

The description of the affected environment in Section 2.11 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Section 4.9, the NRC staff concludes that the radiological impacts to construction workers engaged in building activities would be SMALL, radiological impacts from NRC-authorized construction would be SMALL, and no further mitigation would be warranted. As described in Section 5.9, the NRC staff concludes that the radiological impacts from normal operations would be SMALL, and no further mitigation would be warranted.

The combined impacts from construction and preconstruction were described in Section 4.9 and were determined to be SMALL. In addition to the impacts from construction, preconstruction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative radiological impacts. For the purposes of this analysis, the geographic area of interest is the area within the 50-mi radius of the Lee Nuclear Station site. Historically, the NRC has used the 50-mi radius as a standard bounding geographic area to evaluate population doses from routine releases from nuclear power plants. The area within a 50-mi radius of the proposed site includes two of Duke's other nuclear stations—McGuire, a two-unit station in Mecklenburg County, North Carolina and Catawba, a two-unit station in York County, South Carolina. South Carolina Electric &Gas's VCSNS and its planned Independent Spent Fuel Storage Installation are just beyond the 50-mi distance, located about 52 mi south of the proposed site. In addition, hospitals and industrial facilities that use radioactive materials are likely to be within the 50-mi radius of the site.

As described in Section 4.9, the estimate of dose to construction workers during the building of proposed Units 1 and 2 is well within NRC annual exposure limits (i.e., 100 millirem [mrem] per year), which are designed to protect the public health. This estimate includes exposure to construction workers at Unit 2 from operation of Unit 1 after Unit 1 begins operation. As described in Section 5.9, the public and occupational doses predicted from the proposed operation of two new units at the Lee Nuclear Station site are well below regulatory limits and standards. Also, based on the estimates of doses to biota given in Section 5.9, the staff concludes that the cumulative radiological impact on biota would not be significant. As stated in Section 5.9.6, Duke plans to conduct a radiological environmental monitoring program (REMP) around the Lee Nuclear Station. The REMP would measure radiation and radioactive materials from all sources, including Lee Nuclear Station, area hospitals, and industrial facilities. The REMP would monitor the levels in the environment to confirm the estimates of radiological impact to the public and biota presented in Section 5.9.

Currently, no other nuclear facilities are planned within 50 mi of the Lee Nuclear Station site; however, VCSNS Units 2 and 3, which were granted COLs in March 2012 and are under construction, would be at about 52 mi from the site. The NRC and South Carolina officials would regulate or control any reasonably foreseeable future actions in the region that could contribute to cumulative radiological impacts.

Therefore, the staff concludes that the cumulative radiological impacts of operating two new units along with the influence of other man-made sources of radiation nearby would be SMALL.

7.9 Nonradioactive Waste Impacts

Cumulative impacts on water and air are discussed in Sections 7.2 and 7.6, respectively. The cumulative impacts of nonradioactive waste destined for land-based treatment and disposal are primarily related to the available capacity of area treatment and disposal facilities and the amount of waste expected to be generated by the proposed project and other reasonably foreseeable projects. As described in Section 4.10, the impacts from NRC-authorized construction on nonradioactive waste would be SMALL, and no further mitigation other than that described in Duke's ER (Duke 2009c) would be warranted. As described in Section 5.10, the review team concludes that the impacts of operations on nonradioactive waste would also be SMALL, and no further mitigation would be warranted.

As described in Section 4.8, the combined nonradioactive health impacts from construction and preconstruction would be SMALL, and no further mitigation would be warranted beyond that described in Duke's ER. During building of proposed Lee Nuclear Station Units 1 and 2, offsite land-based waste treatment and disposal would be minimized by storing spoils generated by excavation and dredging at the site and reusing them onsite whenever possible (Duke 2009c). Duke (2009c) also stated it may consider recycling woody debris generated from onsite clearing activities for beneficial use such as mulch for landscaping. Building activities would generate small quantities of construction debris and the construction workforce would produce small quantities of municipal solid waste (MSW). In South Carolina, Class 1 landfills accept land-clearing debris; Class 2 landfills accept construction and demolition debris; and Class 3 landfills accept MSW. The City of Gaffney and Cherokee County each have one Class 2 landfill permitted to accept up to 8,930 and 20,000 T/y of waste, respectively. The estimated remaining life of these landfills is 34 and 29 years, respectively (SCDHEC 2011b). Due to Duke's efforts to recycle construction and demolition debris and the availability of landfill space, cumulative impacts of increased nonradioactive waste during building of proposed Lee Nuclear Station Units 1 and 2 would be minimal.

During operation, Duke would ship MSW and recyclable materials offsite to municipal or county solid waste facilities (Duke 2009c). Most of the projects listed in Table 7-1 typically produce MSW, and energy and manufacturing facilities could produce small quantities of hazardous wastes. Some projects in Table 7-1 would produce waste streams of a different nature (e.g., mining and park projects). Cherokee County does not have a MSW landfill; however, regional landfills are available in upstate South Carolina (SCHDEC 2011b). As of 2010, South Carolina had 25 SCDHEC-permitted Class 3 landfills (SCDHEC 2011b). Based on an estimate for the Levy Nuclear Station, another proposed two-unit (AP1000) nuclear station, Lee Nuclear Station would likely generate approximately 1600 T/y of MSW (PEF 2009). From 2008 through 2010, Duke's recycling rate increased from 52 to 63 percent (Duke Energy 2011a). Because adequate landfill capacity exists in South Carolina, and Duke would continue to implement an aggressive recycling program, cumulative impacts of increased nonradioactive waste generation during operation of proposed Lee Nuclear Station Units 1 and 2 would be minimal.

Duke anticipates that the proposed Lee Nuclear Station would be classified as a conditionally exempt small quantity generator (CESQG) of hazardous wastes under the Resource Conservation and Recovery Act (RCRA) (Duke 2009c). Among other rules, CESQGs must produce less than 220 lb of hazardous waste in one calendar month (EPA 2008d). Duke (2009c) states that hazardous wastes would be treated, stored, and disposed of in accordance with RCRA, and any other applicable Federal, State, and local laws and regulations. Some coal or natural gas energy projects and manufacturing projects listed in Table 7-1 could also produce hazardous waste; however, these facilities would also be required to comply with RCRA and SCDHEC regulations regarding the treatment, storage, and disposal of hazardous waste. Therefore, cumulative impacts from the generation of hazardous wastes would be expected to be minimal.

Based on the available treatment and disposal capacity in South Carolina for MSW and construction, demolition, and land-clearing debris, and the expected generation of only minimal mixed and hazardous waste, the review team concludes that cumulative impacts of nonradioactive and mixed waste would be SMALL, and additional mitigation would not be warranted.

7.10 Impacts of Postulated Accidents

As described in Section 5.11.1, the staff concludes that the environmental consequences of design basis accidents (DBAs) at the Lee Nuclear Station site would be SMALL for an AP1000 reactor. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The consequences of DBAs are bounded by the consequences of severe accidents. As described in Section 5.11.2, the NRC staff concludes that the severe-accident probability-weighted consequences (i.e., risks) of an AP1000 reactor at the Lee Nuclear Station site are SMALL compared to risks to which the population is generally exposed, and no further mitigation would be warranted.

The cumulative analysis considers risk from potential severe accidents at all other existing and proposed nuclear power plants that have the potential to increase risks at any location within

50 mi of the proposed Lee Nuclear Station Units 1 and 2. The 50-mi radius was selected to cover any potential risk overlaps from two or more nuclear plants. Existing reactors that contribute to risk within this geographic area include VCSNS Unit 1; H.B. Robinson Unit 2; Oconee Units 1, 2, and 3; Catawba Units 1 and 2; and McGuire Units 1 and 2. In addition, an Independent Spent Fuel Storage Installation has been proposed and two reactors (Units 2 and 3) are under construction at the VCSNS site. Nuclear Fuel Services Inc., located in Erwin, Tennessee, and the Westinghouse Fuel Manufacturing Plant near Columbia, South Carolina, are also within the geographic area of interest.

Tables 5-15 and 5-16 in Section 5.11.2 provide comparisons of estimated risk for the proposed AP1000 units at the Lee Nuclear Station site and current-generation reactors. The estimated population dose risk for the proposed AP1000 units at the Lee Nuclear Station site is well below the mean and median value for current-generation reactors. In addition, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For existing plants within the geographic area of interest, namely VCSNS Unit 1; H.B. Robinson Unit 2; Oconee Units 1, 2, and 3; Catawba Units 1 and 2; and McGuire Units 1 and 2 nuclear generating stations, the Commission has determined that the probability-weighted consequences of severe accidents are SMALL (10 CFR 51, Appendix B, Table B-1). Finally, according to the *Final Environmental Impact Statement for Combined Licenses for VCSNS Units 2 and 3* (NRC 2011f), the risks from VCSNS Units 2 and 3 would also be well below risks for current-generation reactors and would meet the Commission's safety goals. The severe-accident risk due to any particular nuclear power plant gets smaller as the distance from that plant increases. However, the combined risk at any location within 50 mi of the Lee Nuclear Station site would be bounded by the sum of risks for all of these operating and proposed nuclear power plants. Even though several plants could potentially be included in the combination, this combined risk would still be low. There is no irradiated fuel located at Nuclear Fuel Services Inc. or the Westinghouse Fuel Manufacturing Plant, and the facilities are designed to prevent inadvertent criticalities; therefore, the additional risk is not significant in the evaluation of the cumulative severe-accident risk for a nuclear power plant at the Lee Nuclear Station site. On this basis, the NRC staff concludes that the cumulative risks from severe accidents at any location within 50 mi of the Lee Nuclear Station likely would be SMALL, and no further mitigation would be warranted.

7.11 Fuel Cycle, Transportation, and Decommissioning Impacts

The cumulative impacts related to the fuel cycle, transportation of radioactive materials (fuel and waste), and facility decommissioning for the proposed site are described below.

7.11.1 Fuel Cycle

As described in Section 6.1, the NRC staff concludes that the environmental impacts of the fuel cycle due to operation of proposed Lee Nuclear Station Units 1 and 2 would be SMALL. Fuel-cycle impacts would occur not only at the Lee Nuclear Station site but also at other locations in the United States or, in the case of foreign-purchased uranium, in other countries as described in Section 6.1.

Other nuclear facilities located within 50 mi of the Lee Nuclear Station site include Catawba Nuclear Station Units 1 and 2 about 25 mi east of the Lee Nuclear Station site and McGuire Nuclear Station Units 1 and 2 about 42 mi northeast of the Lee Nuclear Station site; the VCSNS site is located 52 mi south of the Lee Nuclear Station site. Table S–3 provides the environmental impacts from uranium fuel-cycle operations for a model 1000-MW(e) light water reactor operating at 80 percent capacity with a 12-month fuel-loading cycle and an average fuel burnup of 33,000 megawatt-days per metric ton of uranium (MWd/MTU). Per 10 CFR 51.51(a), the NRC staff concludes that those impacts would be acceptable for the 1000-MW(e) reference reactor. The impacts of producing and disposing of nuclear fuel include mining the uranium ore, milling the ore, converting the uranium oxide to uranium hexafluoride, enriching the uranium hexafluoride, fabricating the fuel (where the uranium hexafluoride is converted to uranium oxide fuel pellets), and disposing of the spent fuel in a proposed Federal waste repository. As discussed in Section 6.1, advances in reactors since the development of Table S–3 in 10 CFR 51.51 would reduce environmental impacts relative to the operating reference reactor. For example, a number of fuel-management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel and separative work (enrichment) requirements. As discussed in Section 6.1, the environmental impacts of fuel-cycle activities for the proposed units would be about three times those presented in Table S–3 of 10 CFR 51.51. The staff concludes the cumulative fuel-cycle impacts of operating the Lee Nuclear Station to be SMALL, and additional mitigation would not be warranted.

7.11.2 Transportation

The description of the affected environment in Section 2.5.2.3 serves as a baseline for the cumulative impacts assessment in this resource area. As described in Sections 4.8.3 and 5.8.6, the review team concludes that impacts of transporting personnel and nonradiological materials to and from the Lee Nuclear Station site would be SMALL. In addition to impacts from preconstruction, construction, and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative transportation impacts. For this analysis, the geographic area of interest is the 50-mi region surrounding the Lee Nuclear Station site.

Nonradiological transportation impacts are related to the additional traffic on the regional and local highway networks leading to and from the Lee Nuclear Station site. Additional traffic would result from shipments of construction materials and movements of construction personnel to and from the site. Additional traffic increases the risk of traffic accidents, injuries, and fatalities. A review of the projects listed in Table 7-1 indicates that other projects in the region could potentially increase nonradiological impacts. The most significant cumulative nonradiological impacts in the vicinity of the Lee Nuclear Station site would result from major construction projects, including the construction at nearby mining projects and highway improvement projects. Traffic flow to and from operating facilities in the region would be of lesser importance because fewer workers and material shipments are needed to support operating facilities than major construction projects.

In Sections 4.8.3 and 5.8.6, the review team concluded that the impacts of transporting construction material and construction and operations personnel to and from the Lee Nuclear Station site would be a small fraction of the existing nonradiological impacts. Based on the magnitude of nonradioactive transportation impacts of nuclear power plant construction relative to the other construction activities already listed, the review team concludes the cumulative nonradiological transportation impacts of constructing and operating the proposed new reactors at the Lee Nuclear Station site and other past, present, and reasonably foreseeable future impacts would be minimal, and no further mitigation would be warranted.

As described in Section 6.2, the NRC staff concludes that impacts of transporting unirradiated fuel to the Lee Nuclear Station site and irradiated fuel and radioactive waste from the Lee Nuclear Station site would be SMALL. In addition to impacts from construction and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to cumulative transportation impacts. For this analysis, the geographic area of interest is the 50-mi region surrounding the Lee Nuclear Station site.

The NRC staff uses the 50-mi radius as a standard bounding geographic area to evaluate the radiological impacts to the public and environment associated with transportation of radioactive materials. The area within a 50-mi radius of the proposed site includes two of Duke's other nuclear stations – McGuire, a two-unit station in Mecklenburg County, North Carolina and Catawba, a two-unit station in York County, South Carolina. SCE&G's VCSNS (Unit 1 and Units 2 and 3 under construction) and its planned Independent Spent Fuel Storage Installation, are just beyond the 50-mi distance, located about 52 mi south of the proposed site. These sites may also contribute to the cumulative radiological impacts of transportation due to sharing highway links with some Lee Nuclear Station site shipments. Radiological impacts of transporting radioactive materials would occur along the routes leading to and from the Lee Nuclear Station site, fuel fabrication facilities, and waste disposal sites located in other parts of the United States. No other major activities with the potential for cumulative radiological impacts from transportation of unirradiated and irradiated fuel were identified in the geographic region of interest. The past, present, and reasonably foreseeable future impacts in the region surrounding the Lee Nuclear Station site are a small fraction of the impacts from natural background radiation.

As discussed in Section 6.2, the proposed new units at the Lee Nuclear Station site would result in the need for additional unirradiated nuclear fuel and generation of additional spent nuclear fuel and radioactive waste. The impacts of transporting this fuel and radioactive waste to and from the Lee Nuclear Station site would be consistent with the environmental impacts associated with transportation of fuel and radioactive wastes from current-generation reactors presented in Table S–4 of 10 CFR 51.52, which the NRC staff considers to be acceptable for the 1000-MW(e) reference reactor. Advances in reactor technology and operations since the development of Table S-4 would reduce environmental impacts relative to the values in Table S–4. For example, fuel-management improvements have been adopted by nuclear power plants to achieve higher performance and to reduce fuel requirements. This leads to fewer unirradiated and spent fuel shipments than those estimated for the 1000-MW(e) reference reactor discussed in 10 CFR 51.52. In addition, advances in shipping cask designs to increase their capabilities would result in fewer shipments of spent fuel to offsite storage or disposal facilities.

Therefore, the NRC staff considers the cumulative radiological and nonradiological transportation impacts of operating the proposed new reactors at the Lee Nuclear Station site to be SMALL, and no further mitigation would be warranted.

7.11.3 Decommissioning

As discussed in Section 6.3, environmental impacts from decommissioning the Lee Nuclear Station are expected to be SMALL because the licensee would have to comply with decommissioning regulatory requirements.

In this cumulative analysis, the geographic area of interest is within a 50-mi radius of the Lee Nuclear Station site. Other nuclear facilities located within 50 mi of the Lee Nuclear Station site include Catawba Nuclear Station Units 1 and 2 about 25 mi east of the Lee Nuclear Station site and McGuire Nuclear Station Units 1 and 2 about 42 mi northeast of the Lee Nuclear Station site; the VCSNS site is located 52 mi south of the Lee Nuclear Station site. In Supplement 1 to the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, the NRC found the impacts on radiation dose to workers and the public, waste management, water quality, air quality, ecological resources, and socioeconomics to be small (NRC 2002). In addition, in Section 6.3, the NRC staff concluded that the impact of GHG emissions on air quality during decommissioning would be minimal. Therefore, the cumulative impacts from decommissioning the Lee Nuclear Station would be SMALL, and additional mitigation would not be warranted.

7.12 Summary of Cumulative Impacts

The review team considered the potential cumulative impacts resulting from construction, preconstruction, and operation of Lee Nuclear Station Units 1 and 2 together with past, present, and reasonably foreseeable future actions in the same resource-specific geographic area of interest. The specific resources that could be affected by the incremental effects of the proposed action and the other actions listed in Table 7-1 were assessed. This assessment included the impacts of construction and operations for the proposed new units as described in Chapters 4 and 5; impacts of preconstruction activities as described in Chapter 4; impacts of fuel cycle, transportation, and decommissioning described in Chapter 6; and impacts of past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could affect the same resources affected by the proposed action. Table 7-4 summarizes the cumulative impacts by resource area.

Table 7-4. Cumulative Impacts on Environmental Resources, Including the Impacts of Proposed Lee Nuclear Station Units 1 and 2

Resource Category	Comments	Impact Level
Land use	In addition to the land requirements for proposed Lee Nuclear Station Units 1 and 2, Make-Up Pond C, transmission lines, and other associated facilities, the surrounding area is expected to experience continued low-density urban growth.	MODERATE
Water-related		
Surface-water use	Potential decrease in the future water supply in the Broad River basin is the primary driver of the review team's MODERATE conclusion.	MODERATE
Groundwater use	Groundwater would not be used for proposed Lee Nuclear Station Units 1 and 2, and no other significant demands on regional groundwater resources were identified.	SMALL
Surface-water quality	Surface-water-quality impacts would be detectable but would not noticeably alter the resource.	SMALL
Groundwater quality	Temporary groundwater-quality impacts resulting from makeup pond level fluctuation could be detectable on a local basis, but would not noticeably alter the resource.	SMALL
Ecology		
Terrestrial and wetland ecosystems	The loss of habitat associated with the proposed Lee Nuclear Station and associated facilities, especially lowland mixed hardwood forest along London Creek and its tributaries and forest habitat along transmission-line corridors, would noticeably impact but not destabilize terrestrial resources, including wildlife and wetlands, in the geographic area of interest.	MODERATE

Table 7-4. (contd)

Resource Category	Comments	Impact Level
Aquatic ecosystems	The loss of a major portion of London Creek and its tributaries during the development of Make-Up Pond C would noticeably alter, but not destabilize, aquatic resources including aquatic biota in the geographic area of interest.	MODERATE
Socioeconomics		
Physical impacts	Physical impacts on aesthetics occurring during preconstruction would be noticeable, with most of the impacts associated with development of the Make-Up Pond C site. Other physical impacts would be minimal.	SMALL to MODERATE
Demography	Small and temporary demographic impacts would occur on the communities nearest the Lee Nuclear Station site associated with building activities for Units 1 and 2.	SMALL
Economic impacts on the community	Substantial beneficial economic impacts from operation of the proposed Lee Nuclear Station would occur in Cherokee County. Other economic impacts in the region would be minimal.	SMALL to LARGE (beneficial)
Infrastructure and community services	Traffic impacts would be noticeable during peak building employment for the proposed Lee Nuclear Station. Other infrastructure and community services impacts would be minimal.	SMALL to MODERATE
Environmental justice	There would be no disproportionately high and adverse cumulative impacts to minority or low-income populations.	SMALL
Historic and cultural resources	Installation of Make-Up Pond C and the transmission lines would noticeably alter but not destabilize cultural resources in the geographic area of interest.	MODERATE
Air quality		
Criteria pollutants	The cumulative impacts on criteria pollutants from air emissions from the Lee Nuclear Station site and other projects would be minimal.	SMALL
Greenhouse gas emissions	The national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing. The proposed Lee Nuclear Station would not significantly contribute to GHG emissions in the region.	MODERATE
Nonradiological health	Cumulative impacts on public and worker nonradiological health would not be noticeable.	SMALL

Table 7-4. (contd)

Resource Category	Comments	Impact Level
Radiological health	Public and occupational doses predicted from operating proposed Lee Nuclear Station Units 1 and 2 are well below regulatory limits and standards. The cumulative radiological impact on biota would not be significant.	SMALL
Nonradioactive waste	There is available treatment and disposal capacity in South Carolina for MSW and construction, demolition, and land-clearing debris, and the generation of mixed and hazardous waste would be minimal.	SMALL
Severe accidents	The probability-weighted consequences of severe accidents are SMALL for all of the existing plants within the geographic area of interest, and the combined risk would also be low.	SMALL
Fuel cycle, transportation, and decommissioning	The cumulative impacts related to the fuel cycle, transportation of radioactive materials (fuel and waste), and facility decommissioning for all nuclear facilities located within 50 mi of the Lee Nuclear Station would be minimal.	SMALL

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11. ABSTRACT (200 words or less)
This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. NRC by Duke Energy Carolinas, LLC (Duke) for two combined construction permits and operating licenses (combined licenses or COLs). The proposed actions requested in Duke's application are (1) NRC issuance of COLs for two nuclear power reactors at the William States Lee III Nuclear Station (Lee Nuclear Station) site in Cherokee County, South Carolina, and (2) U.S. Army Corps of Engineers (USACE) permit action on a Department of the Army individual permit application to perform certain construction activities on the site. The USACE is participating with the NRC in preparing this EIS as a cooperating agency and participates collaboratively on the review team.
This EIS includes the review team's analysis that considers and weighs the environmental impacts of building and operating two new nuclear units at the proposed Lee Nuclear Station site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts. The EIS includes the evaluation of the proposed project's impacts on waters of the United States pursuant to Section 404 of the Clean Water Act.

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Abstract

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by Duke Energy Carolinas, LLC (Duke) for two combined construction permits and operating licenses (combined licenses or COLs). The proposed actions requested in Duke's application are (1) NRC issuance of COLs for two nuclear power reactors at the William States Lee III Nuclear Station (Lee Nuclear Station) site in Cherokee County, South Carolina, and (2) U.S. Army Corps of Engineers (USACE) permit action on a Department of the Army individual permit application to perform certain construction activities on the site. The USACE is participating with the NRC in preparing this EIS as a cooperating agency and participates collaboratively on the review team.

This EIS includes the review team's analysis that considers and weighs the environmental impacts of building and operating two new nuclear units at the proposed Lee Nuclear Station site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts. The EIS also addresses Federally listed species, cultural resources, and plant cooling-system design alternatives.

The EIS includes the evaluation of the proposed project's impacts on waters of the United States pursuant to Section 404 of the Clean Water Act. The USACE will conduct a public interest review in accordance with the guidelines promulgated by the U.S. Environmental Protection Agency under authority of Section 404(b) of the Clean Water Act. The public interest review, which will be addressed in the USACE's permit decision document, will include an alternatives analysis to determine the least environmentally damaging practicable alternative.

After considering the environmental aspects of the proposed NRC action, the NRC staff's recommendation to the Commission is that the COLs be issued as requested.[a] This recommendation is based on (1) the application, including Revision 1 of the environmental report (ER) and the supplement to the ER, submitted by Duke; (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the two public scoping processes and the draft EIS comment period; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. The USACE will issue its Record of Decision based, in part, on this EIS.

(a) As directed by the Commission in CLI-12-16, the NRC will not issue the COLs prior to completion of the ongoing rulemaking to update the Waste Confidence Decision and Rule (see Section 6.1.6 of this EIS).

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Executive Summary

This environmental impact statement (EIS) presents the results of an U.S. Nuclear Regulatory Commission (NRC) environmental review of an application for combined construction permits and operating licenses (combined licenses or COLs) for two new nuclear reactor units at a proposed site in Cherokee County, South Carolina. The U.S. Army Corps of Engineers (USACE) participated in the preparation of the EIS as a cooperating agency and as a member of the review team, which consisted of the NRC staff, its contractor staff, and the USACE staff.

Background

On December 12, 2007, Duke Energy Carolinas, LLC (Duke), submitted an application to the NRC for COLs for William States Lee III Nuclear Station (Lee Nuclear Station) Units 1 and 2 in Cherokee County, South Carolina. The application was revised (Revision 1) by a letter dated March 30, 2009, and a supplement to the environmental report (ER) was submitted on September 24, 2009, describing Duke's plans to construct and operate an additional offsite reservoir (known as Make-Up Pond C) as a source of supplemental cooling water for the proposed station.

Upon docketing of Duke's initial application, the NRC review team began the environmental review process as described in 10 CFR Part 51 by publishing in the *Federal Register* on March 20, 2008, a Notice of Intent to prepare an EIS and conduct scoping. With the submittal of the September 2009 supplement to the ER, a second Notice of Intent to conduct a supplemental scoping process was published in the *Federal Register* on May 24, 2010. As part of the environmental review, the review team:

- considered comments received during the 60-day scoping process beginning March 20, 2008, and conducted related public scoping meetings on May 1, 2008 in Gaffney, South Carolina.
- considered comments received during a supplemental scoping period specific to Make-Up Pond C from May 24, 2010 through July 2, 2010, and conducted a related public scoping meeting on June 17, 2010, also in Gaffney, South Carolina.
- conducted site audits from April 28, 2008 through May 2, 2008 and from August 9, 2010 through August 13, 2010.
- conducted public meetings on the draft EIS on January 19, 2011 in Gaffney, South Carolina. The review team also considered comments received during the 75-day comment period for the draft EIS beginning on December 12, 2011.

- reviewed Duke's ER and Supplemental ER and developed requests for additional information (RAIs) using guidance from NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants."
- consulted with American Indian Tribes and Federal and State agencies such as U.S. Fish and Wildlife Service, Advisory Council on Historic Preservation, National Marine Fisheries Service, Federal Energy Regulatory Commission, South Carolina Department of Natural Resources, South Carolina Department of Health and Environmental Control, and South Carolina Archives and History Center.

Proposed Action

The proposed actions related to the Lee Nuclear Station Units 1 and 2 application are (1) NRC issuance of COLs for construction and operation of two new nuclear plants at the Lee Nuclear Station site and (2) USACE issuance of a permit pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) as amended to perform certain construction activities on the site.

Purpose and Need for Action

The purpose of the proposed action—issuance of the COLs—is to construct and operate two new nuclear units to provide for additional baseload electric generating capacity in 2024 and 2026 within Duke's service territories. The objective of Duke's requested USACE action is to obtain a Department of the Army individual permit to perform regulated dredge-and-fill activities that would affect wetlands and other waters of the United States.

Public Involvement

A 60-day scoping period was held from March 20, 2008 through May 20, 2008. A supplemental scoping period specific to Make-Up Pond C was held from May 24, 2010 through July 2, 2010. On June 17, 2010, the NRC held supplemental public scoping meetings in Gaffney, South Carolina. The review team received many oral comments during the public meetings and a total of 35 e-mails and 14 letters from both scoping periods on topics such as surface-water hydrology, ecology, socioeconomics, uranium fuel cycle, energy alternatives, and benefit-cost balance.

Additionally, on January 19, 2012, during the 75-day comment period on the draft EIS, the review team held public meetings in Gaffney, South Carolina. Approximately 250 people attended the public meetings and many provided oral comments.

Affected Environment

As proposed, the Lee Nuclear Station would be constructed in Cherokee County, South Carolina, on the same site as the former Duke Power Company Cherokee Nuclear Station. The site is 8 mi southeast of Gaffney, South Carolina and 25 mi northeast of Spartanburg, South Carolina. The area around the site is shown in Figure ES-1.

Cooling water for the units would be obtained from the Broad River. Makeup water from the Broad River would be provided to the plant via Make-Up Pond A. During periods of low flow when withdrawals from the Broad River are limited, makeup water would be provided from Make-Up Ponds B and C to Make-Up Pond A. Make-Up Ponds A and B already exist on the Lee Nuclear Station site. Make-Up Pond C would be built on the London Creek watershed to the northeast of the site. Construction of Make-Up Pond C would disturb approximately 1100 ac with permanent or temporary loss and alteration from flooding and clearing.

The Lee Nuclear Station would use mechanical draft cooling towers to transfer waste heat to the atmosphere. A portion of the water obtained from the Broad River would be returned to the environment via a discharge structure located in the Broad River on the upstream side of Ninety-Nine Islands Dam. The remaining portion of the water would be released to the atmosphere via evaporative cooling.

Evaluation of Environmental Impacts

When evaluating the environmental impacts associated with nuclear power plant construction and operations, the NRC's authority is limited to construction activities related to radiological health and safety or common defense and security; that is, NRC-authorized activities are related to safety-related structures, systems, or components, and may include pile driving; subsurface preparation; placement of backfill, concrete, or permanent retaining walls within an excavation; installation of foundations; or in-place assembly, erection, fabrication, or testing. In this EIS, the NRC review team evaluates the potential environmental impacts of the construction and operation of two new nuclear units for the following resource areas:

- land use
- air quality
- aquatic ecology
- terrestrial ecology
- surface and groundwater
- waste (radiological and nonradiological)
- human health (radiological and nonradiological)
- socioeconomics
- environmental justice
- cultural resources

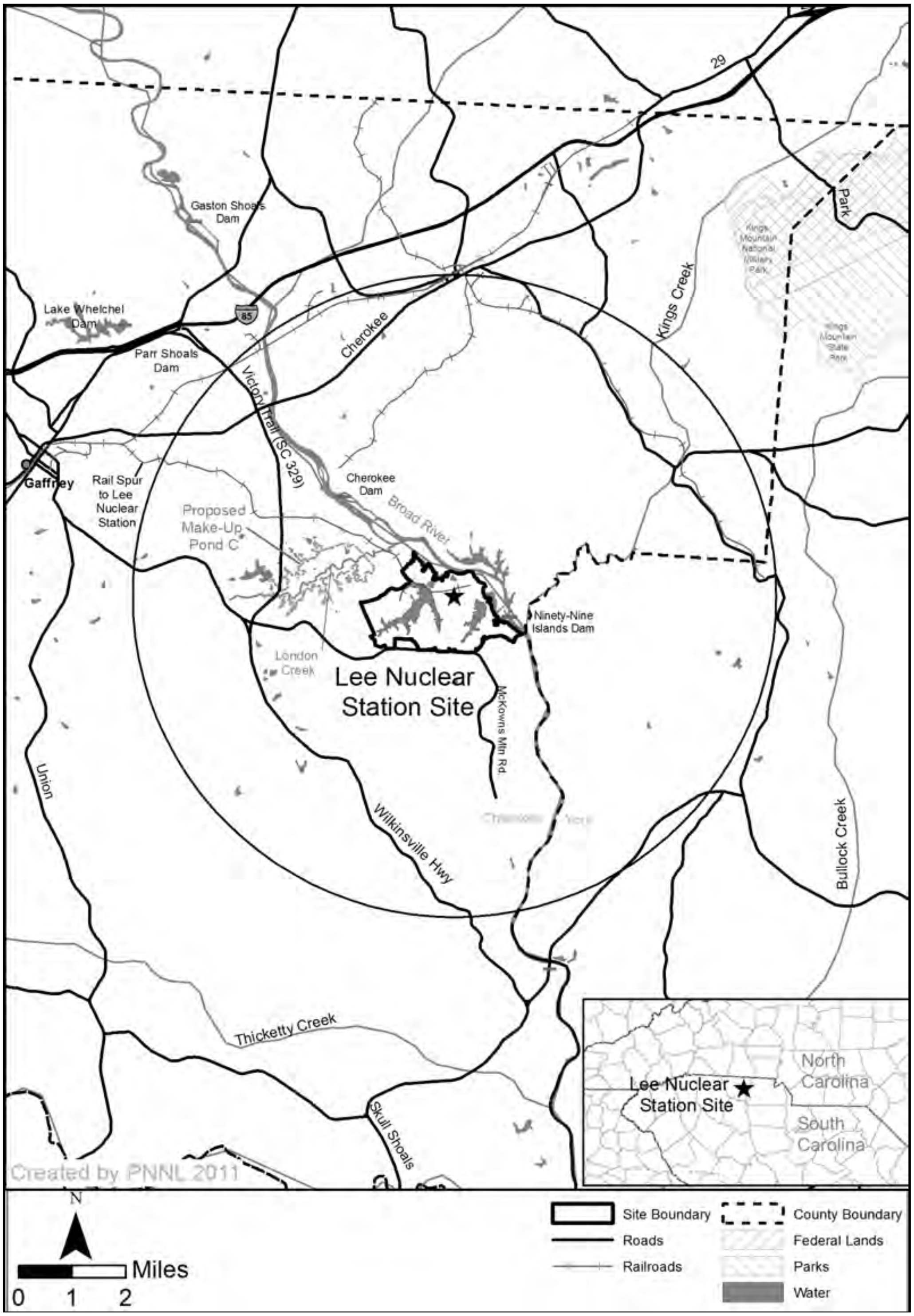

Figure ES-1. Lee Nuclear Station Site

It also evaluates impacts associated with accidents, the fuel cycle, decommissioning, and transportation of radioactive materials.

SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impacts are designated as SMALL, MODERATE, or LARGE. The incremental impacts related to the construction and operations activities requiring NRC authorization are described and characterized, as are the cumulative impacts resulting from the proposed action when the effects are added to, or interact with, other past, present, and reasonably foreseeable future effects on the same resources.

The review team found that the cumulative environmental impacts on most aspects of water use and quality, most socioeconomic areas (adverse only), environmental justice, nonradiological and radiological health, severe accidents, fuel cycle, decommissioning, and transportation would be SMALL. The cumulative impacts for physical impacts and infrastructure and community services would be SMALL to MODERATE.

The review team found that the cumulative environmental impacts on land use, surface-water use, terrestrial and wetland ecosystems, aquatic ecosystems, air quality, and historic and cultural resources would be MODERATE. The impacts from NRC-authorized activities would be SMALL for all of the above-listed resource areas. The incremental impacts associated with the development of transmission lines and Make-Up Pond C would be the principal contributors to the MODERATE cumulative land-use impacts. Potential future water-supply issues in the Broad River Basin would be the primary driver for the MODERATE impact for surface-water use. Cumulative terrestrial and wetland ecosystem impacts would be MODERATE because of the loss of habitat from development of transmission-line corridors. The development of Make-Up Pond C would have cumulative aquatic ecosystem impacts on London Creek and its tributaries. The MODERATE cumulative impact on air quality would result from the existing concentration of greenhouse gases in the atmosphere. The review team found cumulative impacts from Make-Up Pond C development and transmission-line corridor development would contribute to the MODERATE impact for historic and cultural resources.

The review team found no LARGE, adverse cumulative impacts.

Table ES-1 provides a summary of the cumulative impacts for the proposed site.

Table ES-1. Cumulative Impacts on Environmental Resources, Including the Impacts of Proposed Lee Nuclear Station

Resource Category	Impact Level
Land use	MODERATE
Water-related	
Surface-water use	MODERATE
Groundwater use	SMALL
Surface-water quality	SMALL
Groundwater quality	SMALL
Ecology	
Terrestrial ecosystems	MODERATE
Aquatic ecosystems	MODERATE
Socioeconomic	
Physical impacts	SMALL to MODERATE
Demography	SMALL
Economic impacts on the community	SMALL to LARGE (beneficial)
Infrastructure and community services	SMALL to MODERATE
Aesthetics and recreation	SMALL
Environmental justice	SMALL
Historic and cultural resources	MODERATE
Air quality	MODERATE
Nonradiological health	SMALL
Radiological health	SMALL
Severe accidents	SMALL
Fuel cycle, transportation, and decommissioning	SMALL

Alternatives

The review team considered the environmental impacts associated with alternatives to issuing COLs for Lee Nuclear Station. These alternatives included a no-action alternative (i.e., not issuing the COLs), and alternative energy sources, siting locations, or system designs.

The **no-action alternative** would result in the COLs not being granted or the USACE not issuing its permit. Upon such a denial, construction and operation of the two units at the Lee Nuclear Station site would not occur and the predicted environmental impacts would not take place. If no other facility would be built or strategy implemented to take its place, the benefits of the additional electrical capacity and electricity generation to be provided would also not occur and the need for baseload power would not be met.

Based on the review team's review of **energy alternatives**, the review team concluded that, from an environmental perspective, none of the viable alternatives is clearly environmentally preferable to building a new baseload nuclear power generation plant at the Lee Nuclear Station site. The review team eliminated several energy sources (i.e., wind, solar, and biomass) from full consideration because they are not currently capable of meeting the need of this project. None of the viable baseload alternatives (natural gas, coal, or a combination of alternatives) was environmentally preferable to the proposed nuclear units.

After comparing the cumulative effects of the proposed site against those of the **alternative sites**, the review team concluded that none of the alternative sites would be environmentally preferable to the proposed site for building and operating a new nuclear power plant. The three alternatives sites selected were the following:

- Perkins site (previously considered for the Perkins Nuclear Station), Davie County, North Carolina (Figure ES-2),
- Keowee site (adjacent to Oconee Nuclear Station), Oconee County, South Carolina (Figure ES-3),
- Middleton Shoals site, Anderson County, South Carolina (Figure ES-4).

Table ES-2 provides a summary of the cumulative impacts for the alternative sites. The review team concluded that all of the sites were generally comparable, and it would be difficult to state that one site is preferable to another from an environmental perspective. In such a case, the proposed site prevails because none of the alternatives is clearly environmentally preferable.

The review team considered various **alternative systems designs**, including seven alternative heat-dissipation systems and multiple alternative intake, discharge, and water-supply systems. The review team identified no alternatives that were environmentally preferable to the proposed Lee Nuclear Station plant systems design.

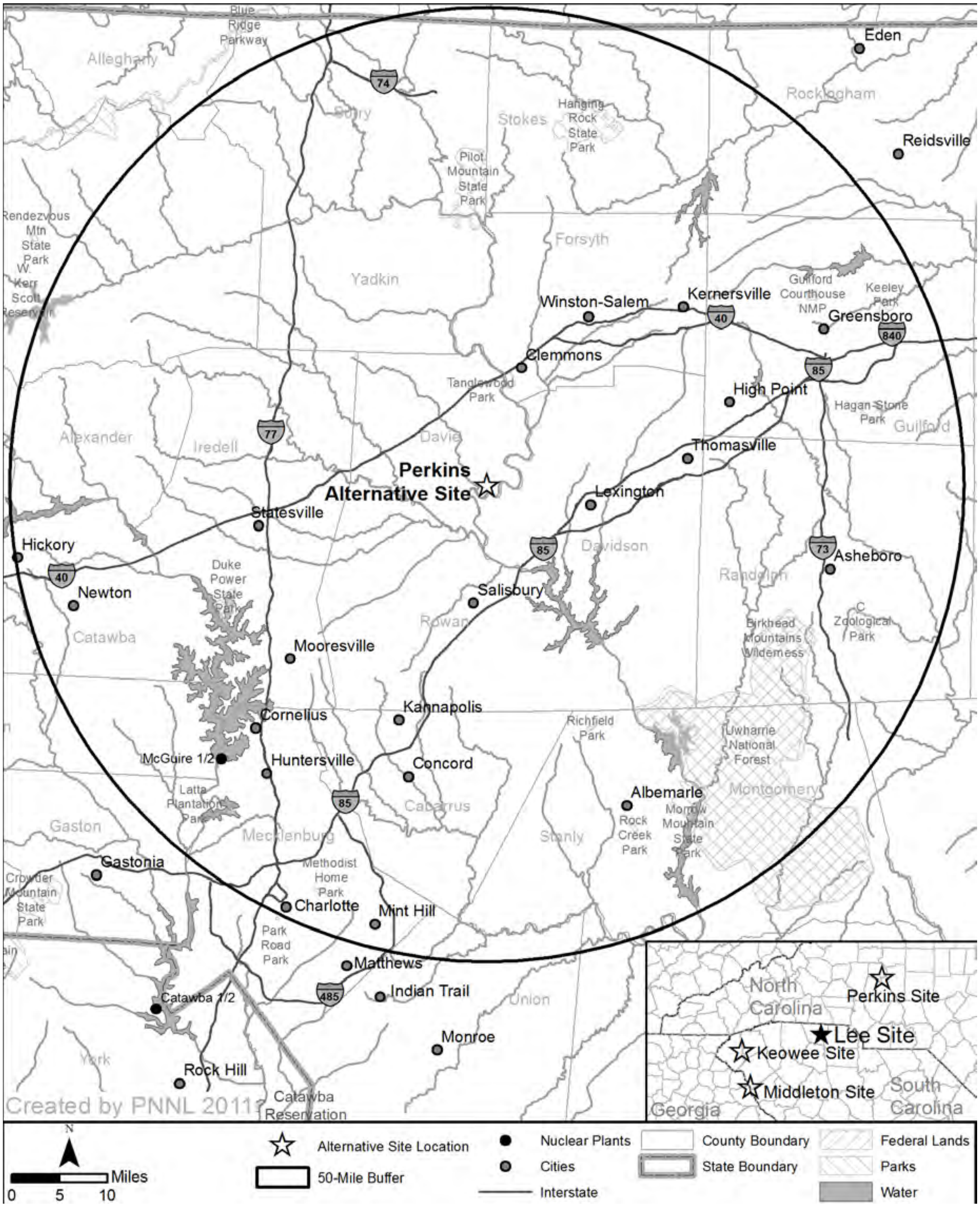

Figure ES-2. Perkins Site

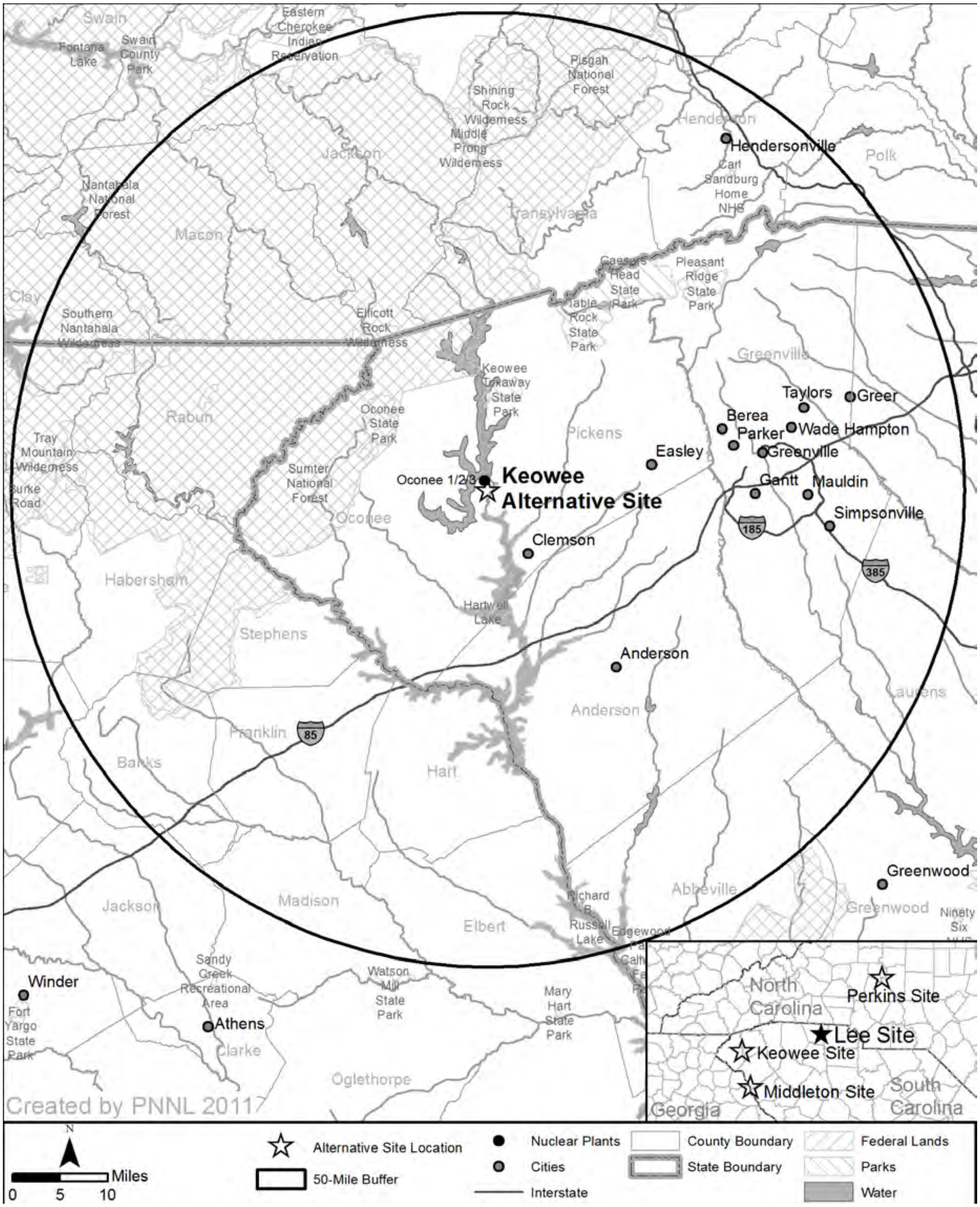

Figure ES-3. Keowee Site

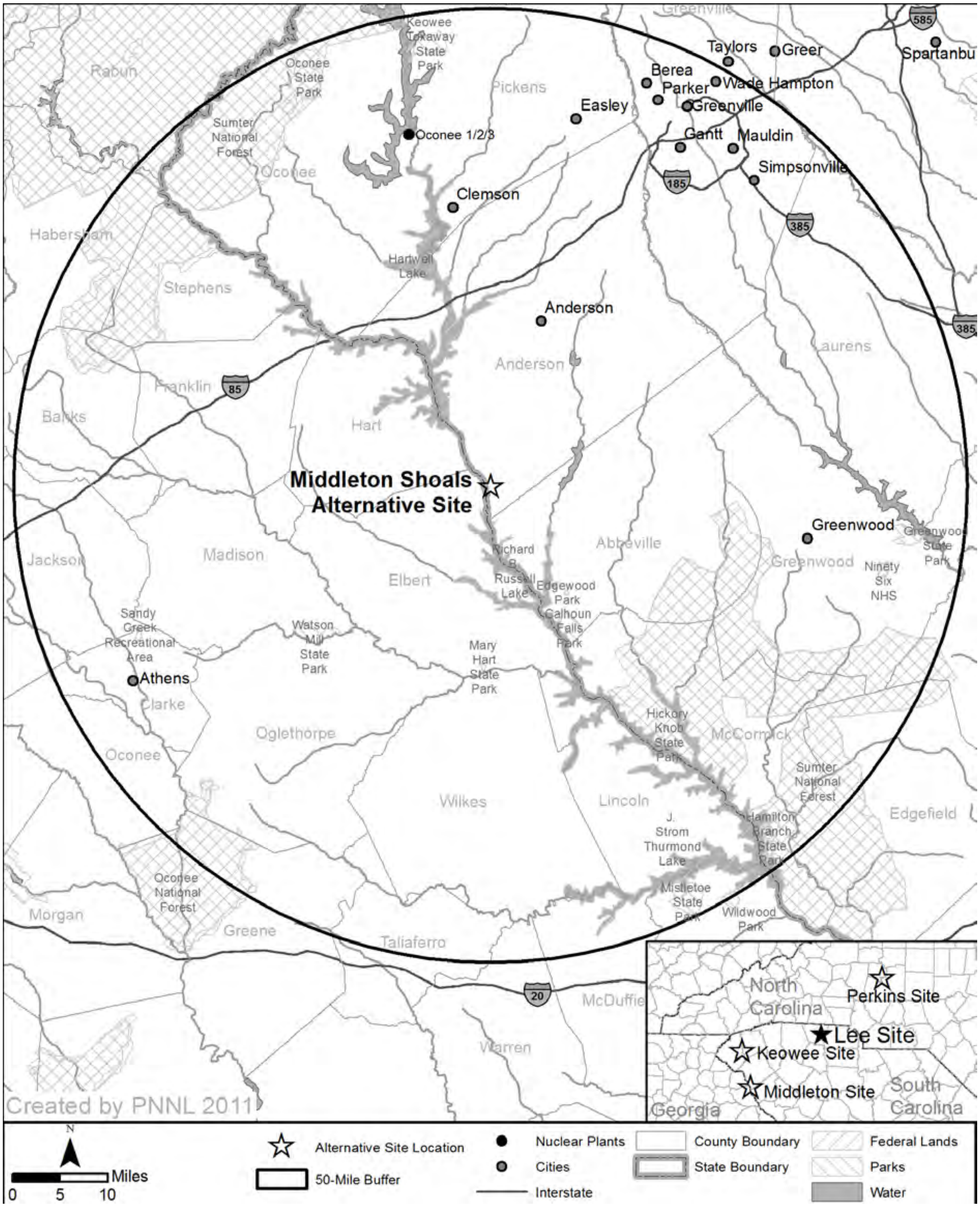

Figure ES-4. Middleton Shoals Site

Benefits and Costs

The review team compiled and compared the pertinent analytical conclusions reached in the EIS. It gathered all of the expected impacts from building and operating the proposed Lee Nuclear Station and aggregated them into two final categories: (1) the expected environmental costs and (2) the expected benefits to be derived from approval of the proposed action. Although the analysis in Section 10.6 is conceptually similar to a purely economic benefit-cost analysis, which determines the net present dollar value of a given project, the intent of the section is to identify potential societal benefits of the proposed activities and compare them to the potential internal (i.e., private) and external (i.e., societal) costs of the proposed activities. In general, the purpose is to inform the COL process by gathering and reviewing information that demonstrates the likelihood that the benefits of the proposed activities outweigh the aggregate costs.

On the basis of the assessments in this EIS, the building and operation of the proposed Lee Nuclear Station, with mitigation measures identified by the review team, would accrue benefits that most likely would outweigh the economic, environmental, and social costs. For the NRC-proposed action (i.e., NRC-authorized construction and operation), the accrued benefits would also outweigh the costs of preconstruction, construction, and operation of the proposed Lee Nuclear Station.

Recommendation

The NRC's recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs should be issued as proposed.

This recommendation is based on the following:

- the application, including the ER and its revisions, submitted by Duke
- consultation with Federal, State, Tribal, and local agencies
- consideration of public comments received during scoping and on the draft EIS
- the review team's independent review and assessment detailed in this EIS.

In making its recommendation, the review team determined that none of the alternative sites is environmentally preferable (and, therefore, also not obviously superior) to the Lee Nuclear Station site. The review team also determined that none of the energy or cooling-system alternatives assessed is environmentally preferable to the proposed action.

The NRC's determination is independent of the USACE's determination of whether the Lee Nuclear Station site is the least environmentally damaging practicable alternative pursuant to Clean Water Act Section 404(b) (1) Guidelines. The USACE will conclude its analysis of both offsite and onsite alternatives in its Record of Decision.

Table ES-2 provides a summary of the EIS-derived cumulative impacts for the proposed site in comparison with the no-action alternative, alternative sites, and energy alternatives.

Table ES-2. Comparison of Environmental Impacts

	Proposed Site[a]	Alternative Sites[b]			Energy Alternatives[c]		
Resource Areas	**Lee**	**Perkins**	**Keowee**	**Middleton Shoals**	**Coal**	**Natural Gas**	**Combination**
Land Use	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Surface Water	MODERATE	MODERATE	MODERATE	MODERATE	SMALL	SMALL	SMALL
Groundwater	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Aquatic Ecosystems	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Terrestrial Ecosystems	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Air Quality	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Socioeconomics	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to MODERATE (beneficial)	MODERATE (adverse) to MODERATE (beneficial)
Environmental Justice	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Cultural Resources	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Human Health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Waste Management	SMALL	SMALL	SMALL	SMALL	MODERATE	SMALL	SMALL

(a) Cumulative impact determinations taken from Table 7-4 in the EIS.
(b) Cumulative impact determinations taken from Table 9-18 in the EIS.
(c) Impacts taken from Table 9-4 in the EIS. These conclusions for energy alternatives should be compared to NRC-authorized activities reflected in Chapters 4, 5, 6.1, and 6.2.

Abbreviations/Acronyms

7Q10	lowest flow for 7 consecutive days expected to occur once per decade
AADT	annual average daily traffic
ac	acre(s)
ac-ft	acre feet
ACS	American Community Survey
AD	Anno Domini
ADAMS	Agencywide Documents Access and Management System
ALARA	as low as reasonably achievable
AP1000	Advanced Passive 1000 pressurized water reactor
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ARRA	American Recovery and Reinvestment Act of 2009
BACT	Best Available Control Technologies
BC	before Christ
BEA	Bureau of Economic Analysis
BEIR	Biological Effects of Ionizing Radiation
BGEPA	Bald and Golden Eagle Protection Act
BLS	Bureau of Labor Statistics
BMP	best management practice
BOD	biochemical oxygen demand
Bq	becquerel(s)
Btu	British thermal unit(s)
°C	degree(s) Celsius
CAES	compressed air-energy storage
CAIR	Clean Air Interstate Rule
CDC	U.S. Centers for Disease Control and Prevention
CDF	core damage frequency
CESQG	conditionally exempt small quantity generator
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic foot/feet per second
Ci	curie(s)
cm	centimeter(s)
CMC	criterion maximum concentration
CO	carbon monoxide
CO_2	carbon dioxide

COL	combined construction permit and operating license
CORMIX	Cornell Mixing Zone Expert System
CPCN	Certificate of Environmental Compatibility and Public Convenience and Necessity
CSAPR	Cross-State Air Pollution Rule
CWA	Clean Water Act (aka Federal Water Pollution Control Act)
CWS	circulating-water system
d	day(s)
DA	Department of the Army
dB	decibel(s)
dBA	decibel(s) on the A-weighted scale
DBA	design basis accident
DBH	diameter breast high
DCD	Design Control Document
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
D/Q	deposition factor(s); annual normalized total surface concentration rate(s)
DSM	demand-side management
DTA	Devine Tarbell & Associates
Duke	Duke Energy Carolinas, LLC
Duke Energy	Duke Energy Corporation
EAB	exclusion area boundary
EE	energy efficiency
EECBG	Energy Efficiency and Conservation Block Grant
EIA	Energy Information Administration
EIS	environmental impact statement
ELF	extremely low frequency
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPT	Ephemeroptera-Plecoptera-Trichoptera (Index)
ER	environmental report
ESP	Early Site Permit
ESRP	Environmental Standard Review Plan
°F	degree(s) Fahrenheit
FAA	Federal Aviation Administration
FES	Final Environmental Statement
FEIS	Final Environmental Impact Statement

FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FP&S	Facilities Planning & Siting
fps	foot (feet) per second
FR	*Federal Register*
FSAR	Final Safety Analysis Report
FSER	Final Safety Evaluation Report
ft	foot/feet
ft^2	square foot/feet
ft^3	cubic foot/feet
FWS	U.S. Fish and Wildlife Service
µg	microgram(s)
g	gram(s)
gal	gallon(s)
GC	gas centrifuge
GCRP	U.S. Global Change Research Program
GD	gaseous diffusion
GDNR	Georgia Department of Natural Resources
GEIS	Generic Environmental Impact Statement
GHG	greenhouse gas
GIS	geographic information system
gpd	gallon(s) per day
gpm	gallon(s) per minute
GWh	gigawatt-hours
HAP	hazardous air pollutant
HDPE	high-density polyethylene
HLW	high-level waste
hr	hour(s)
Hz	hertz
HZI	hydraulic zone of influence
I	U.S. Interstate
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IGCC	integrated gasification combined cycle
in.	inch(es)
INEEL	Idaho National Engineering and Environmental Laboratory
IRP	Integrated Resource Plan
IRWST	in-containment refueling water storage tank

ISFSI	independent spent fuel storage installation
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
km/hr	kilometer(s) per hour
kV	kilovolt(s)
kW	kilowatt(s)
kW(e)	kilowatt(s) electric
kWh	kilowatt-hour(s)
L	liter(s)
LEDPA	least environmentally damaging practicable alternative
LFG	landfill-based gas
LLC	Limited Liability Company
LLW	low-level waste
LOS	level of service
LPZ	low-population zone
LWA	Limited Work Authorization
LWR	light water reactor
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
m^3/s	cubic meter(s) per second
MACCS2	Melcor Accident Consequence Code System Version 1.12
mg	milligram(s)
MEI	maximally exposed individual
Mgd	million gallon(s) per day
mGy	milligray(s)
mi	mile(s)
mi^2	square mile(s)
mL	milliliter(s)
mm	millimeter(s)
MMS	U.S. Department of Interior Minerals Management Service
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MOX	mixed oxides
mpg	mile(s) per gallon
mph	mile(s) per hour
mrad	millirad

mrem	millirem
MSDS	material safety data sheets
MSL	mean sea level
mSv	millisievert(s)
MSW	municipal solid waste
MT	metric ton(nes)
MTU	metric ton(nes) uranium
MW	megawatt(s)
MW(e)	megawatt(s) electric
MWh	megawatt-hour(s)
MW(t)	megawatt(s) thermal
MWd	megawatt-day(s)
MWd/MTU	megawatt-days per metric ton of uranium
NA	not applicable
NAAQS	National Ambient Air Quality Standard
NAGPRA	Native American Graves Protection and Repatriation Act
NC	North Carolina
NCDENR	North Carolina Department of Environment and Natural Resources
NCI	National Cancer Institute
NCRP	National Council on Radiation Protection and Measurements
NCUC	North Carolina Utility Commission
NCWRC	North Carolina Wildlife Resources Commission
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act of 1969, as amended
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NGCC	natural gas combined cycle
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NSPS	new source performance standard
NSR	new source review

NUREG	U.S. Nuclear Regulatory Commission technical document
NVC	National Vegetation Classification
NWI	National Wetlands Inventory
NWS	National Weather Service
OCS	outer continental shelf
ODCM	Offsite Dose Calculation Manual
OECD	Organization for Economic Cooperation and Development
OSHA	Occupational Safety and Health Administration
pH	measure of acidity or basicity in solution
PIRF	public interest review factor
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter 2.5 microns or less
PNNL	Pacific Northwest National Laboratory
pp.	pages
ppb	part(s) per billion
ppm	part(s) per million
PRA	probabilistic risk assessment
PSCSC	Public Service Commission of South Carolina
PSD	Prevention of Significant Deterioration (Permit)
PUC	public utility commission
PURC	Public Utility Review Committee
PURPA	Public Utility Regulatory Policies Act of 1978
PV	photovoltaic
PWR	pressurized water reactor
PWS	potable water service
rad	radiation absorbed dose
RAI	Request(s) for Additional Information
RCRA	Resource Conservation and Recovery Act of 1976, as amended
REC	renewable energy credit(s)
rem	roentgen equivalent man
REMP	radiological environmental monitoring program
REPS	renewable energy portfolio standard(s)
RFP	request for proposal
RIMS II	Regional Input-Output Modeling System
RM	river mile
ROI	region of interest

ROW	right-of-way
RRS	(SERC's) Reliability Review Subcommittee
RWS	raw water service
Ryr	reactor year
μS/cm	microsievert(s) per centimeter
s or sec	second(s)
SACTI	Seasonal/Annual Cooling Tower Impact (prediction code)
SAMA	severe accident mitigation alternative
SAMDA	severe accident mitigation design alternative
SC	South Carolina
SCBCB	South Carolina Budget and Control Board
SCDAH	South Carolina Department of Archives and History
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCDOT	South Carolina Department of Transportation
SCDSS	South Carolina Department of Social Services
SCE&G	South Carolina Electric and Gas
SCIAA	South Carolina Institute of Archaeology and Anthropology
SCR	selective catalytic reduction
SDS	sanitary drainage system
SER	Safety Evaluation Report
SERC	Southeastern Electric Reliability Council
SHA	seismic hazard analysis
SHPO	State Historic Preservation Office (or Officer)
SMCL	secondary maximum concentration limits
SO_2	sulfur dioxide
SO_x	oxides of sulfur
SPCCP	Spill prevention, control, and countermeasure plan
SRS	Savannah River Site
Sv	sievert(s)
SWPPP	stormwater pollution prevention plan
SWS	service-water system
T	ton(s)
T&E	threatened and endangered
TDS	total dissolved solids
TEDE	total effective dose equivalent
THPO	Tribal Historic Preservation Officer
TRAGIS	Transportation Routing Analysis Geographic Information System

TSC	technical support center
UF_6	uranium hexafluoride
UMTRI	University of Michigan Transportation Research Institute
UO_2	uranium dioxide
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
US	U.S. (State Highway)
VACAR	Virginia-Carolinas (subregion)
VCSNS	Virgil C. Summer Nuclear Station
VEGP	Vogtle Electric Generating Plant
VOC	volatile organic compound
WCD	waste confidence decision
Westinghouse	Westinghouse Electric Company, LLC
WWS	wastewater service
χ/Q	atmospheric dispersion factor(s); annual average normalized air concentration value(s)
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)
yr^{-1}	per year

8.0 Need for Power

Chapter 8 of the U.S. Nuclear Regulatory Commission's (NRC's) Environmental Standard Review Plan (ESRP) (NRC 2000a) guides the NRC staff's review and analysis of the need for power for a proposed nuclear power plant. The guidance states:

> Affected states or regions continue to prepare need-for-power evaluations for proposed energy facilities. The NRC will review the evaluation for the proposed facility and determine if it is (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. If the State's or region's need-for-power evaluation is found acceptable, no additional independent review by NRC is needed, and the State's analysis can be the basis for ESRPs 8.2 through 8.4 (NRC 2000a).

In a 2003 response to a petition for rulemaking, the NRC reviewed whether the need for power should be considered in NRC environmental impact statements (EISs) prepared in conjunction with applications that could result in new plant construction (68 FR 55905). The NRC concluded that "…need for power must be addressed in connection with new power plant construction so that the NRC may weigh the likely benefits (e.g., electrical power) against the environmental impacts of constructing and operating a nuclear power reactor." The NRC also stated in its response to the petition discussed above that (1) the NRC does not supplant the States, which have traditionally been responsible for assessing the need for power-generating facilities, for their economic feasibility, and for regulating rates and services; and (2) the NRC has acknowledged the primacy of State regulatory decisions regarding future energy options (68 FR 55905).

As identified in Section 1.3 of this EIS, the purpose and need for the project is to provide for additional baseload electric-generating capacity. The proposed William States Lee III Nuclear Station (Lee Nuclear Station) consists of two Westinghouse Advanced Passive 1000 (AP1000) nuclear power plants providing a combined net electrical output of approximately 2234 MW(e) of baseload-generating capacity. Unit 1 is projected to enter commercial service in 2024, while Unit 2 is projected to enter commercial service in 2026[a] (Duke 2013b). Duke Energy Carolinas, LLC (Duke) would own and operate 100 percent of the plant and its respective power

(a) On October 15, 2013, Duke submitted its 2013 Integrated Resource Plan (IRP) to the North Carolina Utilities Commission (NCUC) and the Public Service Commission of South Carolina (PSCSC). In this document Duke modified the in-service dates for the two units from 2022 and 2024, to 2024 and 2026, and also made some adjustments to its projections for future generation sources including energy efficiency. However, the review team determined that the changes in the updated IRP do not materially change the analysis or the results of that analysis. Therefore, the analysis that follows has not been modified to address the 2013 IRP, which had not yet been reviewed and approved by the NCUC and the PSCSC at the time this final EIS was completed.

capacity. It is also noted that Duke has provided an option to the Jacksonville Electric Authority to purchase up to 20 percent of the proposed Lee Nuclear Station (Duke 2012a). In addition, Duke is performing due diligence to acquire a minority portion of Santee Cooper's 45 percent ownership stake in the V.C. Summer Nuclear Generating Station. As there are no firm commitments to date, the full nuclear portfolio (capacity of the Lee Nuclear Station only) was considered the base case for analysis (Duke 2012a).

The State of South Carolina frames the term baseload plant as a unit or facility "designed to be operated at a capacity factor exceeding 70 percent annually, has a gross initial generation capacity of 350 MW(e) or more, and is intended in whole or in part to serve retail customers of a utility of South Carolina" (South Carolina [SC] Code Ann. 58-33-220). The purpose of the proposed project is consistent with the definition as offered by the State.

Duke is an electric utility as defined by Title 10 of the *Code of Federal Regulations* (CFR) 50.2 and is subject to the regulations of its respective retail regulators and the Federal Energy Regulatory Commission (FERC). Duke's proposed need for power is subject to the regulatory review of both the State of North Carolina through the North Carolina Utilities Commission (NCUC); and the State of South Carolina through the Public Service Commission of South Carolina (PSCSC) through the annual review and evaluation of Duke's Integrated Resource Plan (IRP).

The following sections describe the need for baseload electric-generating capacity. Section 8.1 reviews the current power system and describes the regional characteristics of the Duke service area. Section 8.1 also reviews and discusses the regulatory guidance provided by the States of North Carolina and South Carolina; the determination of the need for power through assessment of the IRP; and concludes with a description of how the need-for-power evaluation performed by the States meets the four required criteria provided by the NRC. Section 8.2 provides a review of pertinent details describing the demand for power, including an assessment of aspects that can impact the demand for power such as regional, State, and Federal policies; energy efficiency (EE) and demand-side management (DSM); and econometric indicators. Section 8.3 discusses the Duke service area power supply, including a review of past, present, and future generating capacity, power purchasing, and policies that may impact supply-side resources. Section 8.4 provides the NRC staff's conclusions regarding the determination of the need for power as proposed by the applicant and verified by the State's evaluation processes.

Where necessary, data and details may be supplemented by information from other independent resources such as State energy offices, regional reliability and power-planning entities (e.g., the Southeastern Electric Reliability Council [SERC], Energy Information Agency [EIA]), and neighboring electric-generating utilities.

8.1 Description of Power System

The following sections describe the Duke service area, the regional reliability of the bulk power-supply system infrastructure related to the North Carolina and South Carolina power system, and the regulatory framework of the States of North Carolina and South Carolina under which the need for power has been evaluated and validated.

8.1.1 Duke Service Area

Duke is one of the largest investor-owned utilities in the United States. It has a rated generating capacity of just over 20,000 MW(e) serving an approximately 22,000 mi^2 area in central and western North Carolina and western South Carolina, with 70 percent of the customer base in North Carolina. In addition to retail sales to over 2.3 million customers across the service area, Duke also sells wholesale electricity to incorporated municipalities and to public and private utilities within the Virginia-Carolinas (VACAR) subregion of the SERC region.

Duke defines the service area as being composed of the geographic region encompassing the franchised service areas in North Carolina and South Carolina, the primary retail customers to be served within that service area, and any reliability-related or wholesale power obligations within that service area (Duke 2009c). As an integrated and regulated electric utility providing service to North Carolina and South Carolina, the primary consideration in the evaluation of installed new power capacity must be meeting the service obligations of current and future customers in the franchised service area. The Duke franchised service area and primary load centers in the North Carolina and South Carolina region are shown in Figure 8-1.

Within the North Carolina and South Carolina franchised service areas, Duke is defined as both an electric supplier and a public utility. Duke is governed by the laws of each State in addition to the rules and regulations of the respective utility commissions. Although the statutory language is somewhat different between the States, both North Carolina and South Carolina require Duke to provide “adequate and reliable” utility service.

The major native load centers within the service area include large municipal areas in North Carolina such as Charlotte, Winston-Salem, and Greensboro. In South Carolina, the territory includes the quickly growing Interstate 85 (I-85) corridor with municipalities of Greenville, Spartanburg, and Anderson continuing to show consistent growth in population and light industry.

The existing Duke customer base as a percentage of sales in gigawatt-hours (GWh) is distributed among the following end users: residential use at 35 percent, commercial (general service) use at 34 percent, industrial use at 25 percent, and wholesale power supply use at 6 percent (Duke 2012b). The historic decline in electrical demand in the industrial base is offset by modest annual growth in both the residential and commercial classes over the same time

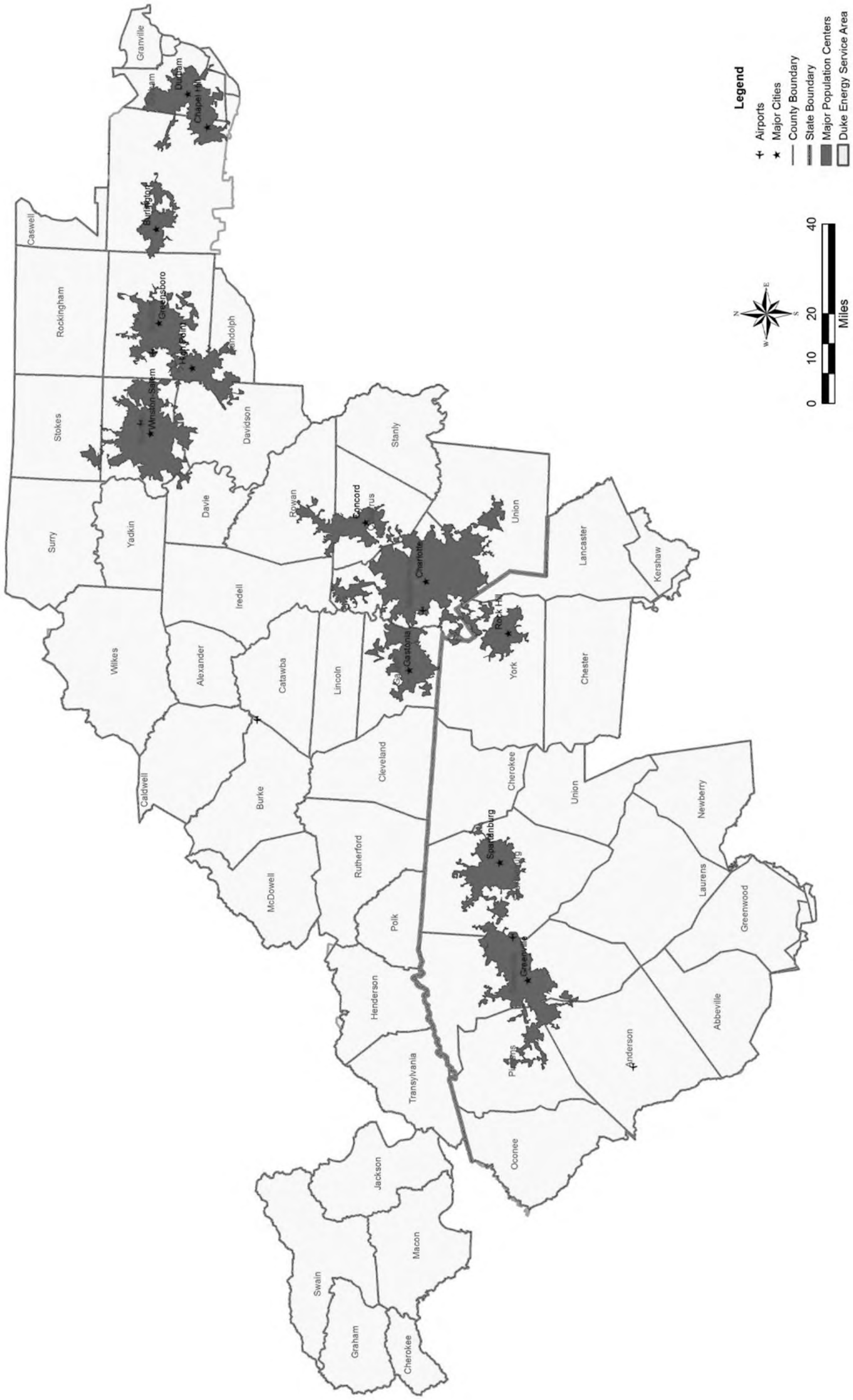

Figure 8-1. Duke Energy Carolinas, LLC Franchised Service Area in North Carolina and South Carolina (Duke 2009c)

period, as well as execution of wholesale power agreements. In year over year analysis, the demand for energy has dropped most recently due to the impacts associated with the economic downturn observed both regionally and nationally. However, retail electricity sales are expected to recover due to steady gains in the regional population and execution of wholesale energy contracts. Accompanied by wholesale power sales obligations, Duke is forecasting a compound annual growth rate for peak demand of 1.7 percent and a growth in energy of 1.6 percent after accounting for EE programs (Duke 2012b).

8.1.2 Regional Reliability and Market Descriptions

Duke generating facilities and transmission systems operate entirely within the VACAR subregion of SERC and are interconnected with both privately owned and State-owned utility systems. SERC serves as a regional entity with delegated authority from the North American Electric Reliability Corporation (NERC) for the purpose of proposing and enforcing reliability standards within the SERC region. In addition, SERC and its various subregions (e.g., VACAR) work to promote and improve the reliability, adequacy, and critical infrastructure of the bulk power-supply systems within the SERC region. Owners, operators, and users of the bulk power-supply system in these states cover the SERC region. The SERC region, as shown in Figure 8-2, is an area of approximately 560,000 mi^2 (SERC 2009).

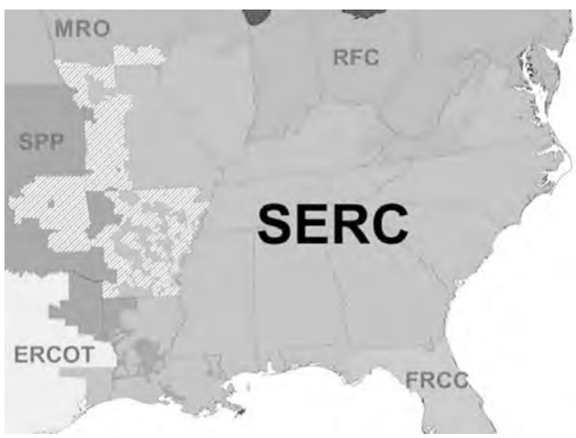

Figure 8-2. The SERC Service Territory (SERC 2009)

As a SERC member, Duke participates in planning, operating, and exchanging information with other SERC members to ensure the continued reliability of interconnected systems and to facilitate periodic reviews of reliability-related activities within the region. The NRC staff found that Duke's annual demand forecasts and electrical growth estimates are consistent with the recent SERC (VACAR) forecasts as compiled in the *Reliability Review Subcommittee's 2012 Annual Report to the SERC Engineering Committee* (SERC 2012). Duke's energy forecast of 1.6 percent annually, which includes retail and wholesale commitments as well as implementation of EE programs, compares reasonably with the VACAR subregion forecast of approximately 1.4 percent annual growth over the next 10 years (SERC 2012). The Duke forecast also asserts that the largest influence on forecasted energy growth is likely based on the impact from EE programs and the significant growth in wholesale energy and power obligations.

Utility commissions in both North Carolina and South Carolina have indicated support for Duke's policy of not relying on generation capacity outside of the service area to meet native baseload requirements, as interruptions in transmission, availability, or capacity may jeopardize the legally binding conditions of the service obligation required of Duke. Further, PSCSC concluded that proposals for purchased power are mandatory only for new peaking generation capacity (PSCSC 2007). The NCUC concluded that policies prohibiting the construction of new baseload generation capacity (e.g., coal and nuclear power plants) may create risks associated with excessive electric rates and unreliable service, and would contravene North Carolina General Statute 62-2(a)(3), requiring reliable and economic utility service to all citizens of the State (NCUC 2006).

Significant non-regulated, uncommitted (merchant) capacity exists in neighboring balancing authority areas with direct interconnection to the Duke service area. This capacity is primarily natural-gas-fired generation. Due to the unknown commitment status of this capacity, transmission access limitations, and physical transmission constraints, the reliable deliverability of this capacity cannot be guaranteed. Therefore, conclusions cannot be drawn regarding the purchase and distribution of merchant capacity within the service territory or in neighboring areas, and the capacity can neither be considered nor modeled as a viable supply of baseload capacity (Duke 2008n). This premise is consistent with a review of non-regulated power capacity within the North Carolina and South Carolina service territories, which indicates a limited amount of total available capacity (EPA 2007c).

8.1.3 Regulatory Framework

Duke is a regulated, investor-owned utility in North Carolina and South Carolina with a designated franchised service area. Duke operates under statutes, regulations, and utility commission rules with a requirement to provide reliable, economical electric service to its customers in both States. As such, Duke is required to either formally report (via the IRP) or provide an annual forecast and resource update to each State utility commission addressing its short- and long-term plans for meeting the capacity and reliability needs of its customers. In North Carolina, the IRP shall be filed biennially with annual updates of forecasts, revisions, and amendments to the biennial report filed each year in which the biennial report is not required (NCUC 2011a). In South Carolina, the IRP must be submitted triennially to the State Energy Office, which, "to the extent practicable, shall evaluate and comment on external environmental and economic consequences of each integrated resource plan." South Carolina utilities are also required to provide annual updates to the IRP, or any time the utility plans to acquire additional generating capacity greater than 12 MW (SC Code Ann 58-37-40). To satisfy both States' jurisdictions and filing requirements, a single plan, or IRP, is filed in both States annually. The need for power assessed in the EIS considered Duke's 2011 IRP, which was filed with the State utility commissions on September 1, 2011. In North Carolina, the IRP was filed under NCUC Docket No. E-100, Sub 128; in South Carolina, it was filed under PSCSC Docket No. 2011-10-E. The 2011 IRP was docketed by the NRC September 15, 2011 (Duke 2011g). The NRC staff also evaluated Duke's 2012 IRP, which was filed September 4, 2012 with the State utility commissions, and docketed by the NRC October 3, 2012 (Duke 2012a).

In North Carolina, the IRP is developed in accordance with NCUC regulations as directed by the State of North Carolina General Statutes 62-2 and 62-110.1. These statutes establish State policy to require regulated utilities such as Duke to perform "energy planning in a manner resulting in the least cost mix of generation and demand reduction measures," and the NCUC to keep "current an analysis of long-range needs for expansion of facilities for the generation of electricity in North Carolina, including probable future growth of the use of electricity, probable needed generation reserves, and the extent, size, mix, and location of generating plants" (Duke 2009c).

In South Carolina, IRPs are filed pursuant to PSCSC orders as directed by the South Carolina Code of Laws Section 58-37-40 requiring "...a plan which contains the demand and energy forecast for at least a 15 year period, contains the suppliers program for meeting the requirements shown in the forecast in an economic and reliable manner." These State-specific laws also require that "for electrical utilities subject to the jurisdiction of the PSCSC, this definition must be interpreted in a manner consistent with the integrated resource planning process adopted by the commission" (SC Code Ann 58-37-40).

8.1.3.1 Integrated Resource Planning Process

Integrated resource planning is built on principles of comprehensive analysis, which involve analyzing the full range of supply-side and demand-side options and assessing them against a common set of planning objectives referencing historical, current, and future projections and policies. Integrated resource planning provides an opportunity for utility planners to address complex issues in a structured, inclusive, and transparent manner. Duke's IRP includes discussion of the current state of the utility including generation; EE and DSM programs; power purchase agreements; 20-year energy and peak forecast and resource need projections; target planning reserve margin; new generation and power purchase agreements; results of the planning process; and near-term actions needed to meet customers energy needs that maintain flexibility if operating environments change (Duke 2012a).

Further, the IRP process provides an opportunity for affected parties—both public and private—to review, understand, and provide additional input to the power-planning process. Provisions require Duke's IRPs to be subject to full disclosure and public review prior to approval by the State utility commissions. In North Carolina, rules governing the IRP annual report allow "…the

Public Staff and any other intervenor to file a report, evaluation, or comments concerning any utility's annual report…" (NCUC 2009a). An evidentiary hearing may be scheduled at the discretion of the NCUC and one or more public hearings must be held.

There are only slight variations to the specific details included in each States' representative IRP. As summarized in Table 8-1, the iterative and comprehensive IRP process provides sufficient detail. The modeling and forecasts are provided as the basis of the IRP and subsequent filings to public utility commissions in North Carolina and South Carolina and the State Energy Office in South Carolina. The public utility commissions retain experts (e.g., PSCSC Office of Regulatory Staff) to assist in reviewing the IRP, developing data requests and reviewing responses, providing testimony and associated reports as needed, and responding to intervention and public requests. In North Carolina, the NCUC, as part of its qualitative and quantitative analysis of the IRP, provides a final order detailing the findings of the commission and offering direction for future IRPs or utility reporting requirements. In South Carolina, though the process of IRP evaluation is similar, neither the PSCSC nor the South Carolina Energy Office executes a formal reporting requirement.

The NCUC and PSCSC can approve the IRP, approve it subject to stated conditions or modifications, approve it in part, reject it in part, reject it in its entirety, or provide an alternative plan.

8.1.3.2 Certificate of Public Convenience and Necessity

A provision in South Carolina State law, the Utility Facility Siting and Environmental Protection Act, requires all persons desiring to construct major utility facilities to obtain a Certificate of Environmental Compatibility and Public Convenience and Necessity (CPCN) from the PSCSC prior to the commencement of any construction activities. This process is governed by SC Code Ann 103-3-1 and 58-33-10 et seq. The proposed project has selected the Lee Nuclear Station site in Cherokee County, South Carolina as its preferred site, and will therefore require a CPCN from the PSCSC prior to construction and operation of the plant.

Pursuant to the Utility Facility Siting and Environmental Protection Act, the PSCSC may not grant a certificate for the construction, operation, and maintenance of a major utility facility, either as proposed or as modified, unless it shall find and determine the basis of the need for the facility; the nature of probable environmental impact; that the impact of the facility upon the environment is justified considering the alternatives; that the facilities serve in the interests of system economy and reliability; that there is reasonable conformance to applicable State and local laws and regulations; and that public convenience and necessity require the construction of the facility (SC Code Ann 58-33-160). The most up-to-date IRP commonly provides the baseline forecast and analysis considered in CPCN hearings when the State is tasked with determining if an applicant has a need for a major utility facility.

Table 8-1. IRP Modeling Process

Develop an econometric-based load forecast.	The IRP must report historic energy data and address at a minimum, the next 15-year demand-side and supply-side forecasts. Forecasting must be weather-normalized and address the jurisdictional area, retail, and wholesale loads; customer classes; and annual load factors. Respective State regulations specify forecasting methodologies and standards for data inputs.
Inventory and account for existing supply-side and demand-side resources as well as assumptions regarding new supply-side and demand-side resources.	The IRP must identify existing resources including power purchases, sales, and exchanges; demand-side programs such as existing EE and DSM programs; cogeneration; standby generation; spinning reserves; pooling or coordination agreements; generation; and transmission. The IRP must address potential new supply-side and demand-side resources and the associated decision-making process including regulations such as renewable portfolio standards or EE policies. The IRP must provide the detail required to objectively evaluate the process for securing long-term new supply-side and demand-side options, and the environmental and economic consequences therein.
Apply screening curves to the supply-side and demand-side options.	Using screening curves, the IRP must determine the most cost-effective supply-side options. The sensitivities must include a reasonable range of energy demand and include low-growth, medium (average)-growth, and high-growth scenarios. Demand-side options (e.g., EE and DSM), are screened based on expected cost, availability, saturation and penetration levels; expected energy savings; and regulatory provisions (e.g., renewable portfolio standards and EE goals).
Identify capacity resource.	Using advanced computer optimization models, expected future load is modeled and screened against cost-effective capacity resources. The results provide potential resource portfolios to test in a detailed analysis.
Provide resource portfolio analysis.	Detailed analysis is performed on the resource portfolios with a variety of sensitivities including fuel and electricity pricing, capital cost, environmental regulations, and load sensitivity.
Identify the optimal portfolios of supply-side and demand-side options.	The modeling process helps identify the best demand-side and supply-side options in terms of cost, EE, reliability, safety, regulatory requirements, risk, and uncertainty.

Source: Duke 2009c

Finally, although Duke selected a South Carolina site for the proposed project and will file for the CPCN through the PSCSC, Duke will also need to satisfy consumer protection aspects found in North Carolina General Statute. Among these are mechanisms enabling Duke to petition the NCUC to consider and determine the need for the facility. As part of the proceedings, Duke must also demonstrate the prudency of rate recovery for the corresponding costs of construction and the reasonableness of project development cost recovery (NC Gen. Statute § 62-110.6(a) and 62-110.7(b)). If approved, the NCUC will offer a final ruling, or order, providing direction for future activities.

Duke has not yet petitioned the State of South Carolina for a CPCN; however, it continues to evaluate the optimal time to file the CPCN in South Carolina (Duke 2012a).

8.1.4 Alignment with NRC NUREG-1555 Criteria

In accordance with the NRC's ESRP, and supplemental guidance (NRC 2000a), the NRC staff reviewed the analytical process and need-for-power evaluation provided in the Duke IRP and performed by the States of North Carolina and South Carolina. Taken in aggregate, the NRC staff found the evaluation process met the four NRC criteria for being (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. The following details how the four NRC criteria were met.

Systematic: The NRC staff determined that Duke has a systematic and iterative process for load forecasting, which must be updated and reviewed annually as directed and codified by each respective State. On September 1, 2011, Duke filed the 2011 IRP (Duke 2011g) in North Carolina under NCUC Docket No. E-100, Sub 128 and in South Carolina under PSCSC Docket No. 2011-10-E. On September 4, 2012, Duke filed its 2012 IRP (Duke 2012a) in North Carolina under NCUC Docket No. E-100, Sub 137 and in South Carolina under PSCSC Docket No. 2012-10-E.

Regulatory provisions, as described previously in North Carolina and South Carolina, ensure that on an annual basis, Duke is providing the most up-to-date forecast and expected resource portfolios respective of all known current and forecasted conditions. The load forecasts use power industry best practices and methodological approaches to determine the utilities need for power and the most cost-effective strategies to meet regulatory obligations. For these reasons, the NRC staff determined the State processes for IRP evaluation are sufficiently systematic for the purposes of this analysis.

Comprehensive: Peak power and energy forecasts incorporate key influencing factors such as regional economic and demographic trends, price of electricity, existing and new EE and DSM impacts, and weather. Forecasts are generated for each sector of the economy, and separate forecasts are developed to determine both short- and long-term demand. Power-supply forecasts include a comprehensive evaluation of present- and planned-generating capabilities, as well as present and planned purchases and sales of power within the Duke service territory. All analyses are performed with forecasting and statistical modeling and methodological approaches appropriate for the power industry. Therefore, the NRC staff found the need for power contained in the IRP and evaluated by the NCUC and PSCSC sufficiently comprehensive for the purposes of this analysis.

Subject to Confirmation: The Duke IRP processes, models, and estimations are documented and subject to evidentiary review and comment by the public, utility regulators, associated or impacted interest groups, and industry experts. Further, the NCUC Public Staff (representing electric consumers in North Carolina) and the PSCSC Office of Regulatory Staff (representing the electric consumers in South Carolina), review, investigate, and make appropriate recommendations to the utility commissions with respect to furnished or proposed services of any public utility. The data, information, and testimony provided enabled the NCUC Public Staff to conclude that the 2010 and 2011 IRPs were reasonable and should have full commission approval. The NCUC approved the 2010 IRP on October 26, 2011 (NCUC 2011e) and the 2011 IRP on May 30, 2012 (NCUC 2012).

The PSCSC publicly vetted and heard testimony regarding the 2011 IRP on December 20, 2011 through the allowable ex parte briefing (PSCSC 2011b). The hearing addressed relevant aspects of the IRP (e.g., load forecasting methodology and accuracy, impacts of Federal and local regulations on supply-side and demand-side measures, and generation planning). Therefore, the NRC staff determined the Duke processes are sufficiently subject to confirmation for the purposes of this analysis.

Responsive to Forecasting Uncertainty: Duke tests the validity of its overall forecast by analyzing the impact of alternative load forecasts (high, medium, and low) (Duke 2009c). In addition, uncertainty in the load forecast is quantified by evaluating the resource portfolios against variations in future sensitivities (e.g., fuel and construction costs, load forecasts, environmental laws and regulations, and risk). In doing so, Duke develops multiple resource portfolios that quantify both short-term and long-term cost to customers under varying potential sensitivities, while understanding the fundamental strengths and weaknesses of various supply-side and demand-side configurations. For the reasons discussed here, the NRC staff determined the Duke processes are sufficiently responsive to forecasting uncertainty for the purposes of this analysis.

In aggregate, the Duke IRP and State evaluation processes satisfy the four reliability criteria in the NRC's ESRP and supplemental guidance (NRC 2000a). The comprehensive forecast under State regulatory purview and approval, when coupled with information from the SERC regional forecast, provides a reasonable basis for an independent analysis and confirmation of the applicant's stated need for power, and for inclusion in this EIS. The following sections further characterize the need for power.

8.2 Power Demand

In Section 8.2.1, the demand for power is discussed for Duke as provided by its 2012 IRP and as evaluated in the State processes. In Section 8.2.2, a final analysis of the demand for power is provided including the State-approved reserve planning margin.

8.2.1 Factors Affecting Demand

In its 2012 IRP, Duke forecasts an average growth in summer peak demand of 1.7 percent; the forecast includes the impacts associated with proposed new EE programs provided in the IRP. Concurrently, the utility forecasts that annual territorial energy need is growing at 1.6 percent (Duke 2012a). Retail load growth analysis includes end-use segments classified as residential, commercial or general services, and industrial. Specific to the region and the Duke service area, a key to the decline in total retail load growth over the past 5 years is the consolidation and continued loss of textile-based industries. This loss has been offset by growth in the residential and general service segments where, depending on the year, approximately 22,000 to 35,000 new residential customers were added to the service area and by significant growth in wholesale obligations. Nevertheless, Duke is forecasting the sum of retail and wholesale energy sales to grow at a modest 1.6 percent annually (Duke 2012a).

Several factors influence the historic and future demand for electricity. Duke prepares and provides forecasts that capture key criteria from several broad-based categories: weather; economic, demographic, and technology trends; EE and DSM; and price and rate structure. In addition to these categories, Duke includes capacity as it relates to regional reserve sharing agreements and overall company reserve margin requirements. Taken collectively, energy forecasts are then developed from econometric models that characterize and correlate historical usage in megawatt-hours (MWh) to key variables within each category. As part of the hearing record, direct testimony was submitted by Duke to the NCUC and reviewed by the NCUC Public Staff as part of Docket No. E-100, Sub 137 (NCUC 2012). The NRC staff reviewed the hearing testimony and the NCUC Public Staff's assessment of the IRP, determining that the forecasts were complete, accurate of known and foreseeable conditions, and properly reflected the effect of key variables on electricity demand in the service area. As of September, 2013, the NCUC Public Staff has proposed acceptance of the Duke Energy 2012 IRP as well as provided instructions for future filings (NCUC 2013); the NCUC Order approving the IRP is pending.

8.2.1.1 Weather

Duke is a summer peaking utility. With EE programs incorporated, peak electricity demand between summer and winter can vary up to 800 MW(e) (Duke 2012a). To accommodate this variation, Duke applies weather adjustment factors on a ‘per-hour’ basis to the forecast model that when applied to the historical seasonal data, produces an estimate similar to actual demand levels, indicating the weather adjustment factors used are a reasonable predictor of near-term future demand. Duke applied these factors against a 20-year median of historic data for the relevant area to develop hourly, monthly, and annual demand forecasts using industry-accepted modeling and verification tools. The accuracy of input variables for each demand forecast were then validated; one such example is the direct comparison of hourly demand forecasts against monthly demand forecasts. The NRC staff reviewed the weather-related analysis of the applicant's IRP and environmental report (ER), and determined it to be reasonable.

8.2.1.2 Economic Trends

One of the principal indicators influencing electrical demand is economic growth. Duke uses both short- and long-term economic forecasts as key indicators of the demand for power. Regional economic projections include variables such as total gross State product in North Carolina and South Carolina for manufacturing and nonmanufacturing sectors, employment trends, and total personal income. Source data are provided by a leading economic forecasting firm (i.e., Economy.com), coupled with direct feedback from end-use segments such as the National Council of Textile Organizations. Final adjustments are made to account for the projected impact of marketing and sales programs targeting these segments which are not necessarily captured within the historical usage data such as the incorporation of Plug-In Hybrid Electric Vehicles into the market or the ban on incandescent lighting (Duke 2012a).

An additional consideration reflected in the forecast is the potential impact(s) from legislative policies that would indirectly impact the price of energy through the regulation of emissions or the required implementation of clean energy technologies. To the extent that these policies could affect consumer behavior, the energy forecast accounts for these measures.

8.2.1.3 Demographic Trends

Electricity demand in the relevant area has predominantly come from growth in residential and commercial customers. Duke estimates that in each of the last 5 years, approximately 22,000 new residential customers have been added to the service area. Population forecasts are obtained directly from county-specific information; collectively, this information is used to derive the total population forecast for the 46 counties that Duke serves. The population forecast is then comparatively assessed against independent reviews such as the 2000 U.S. Census information (USCB 2005), which is estimating growth of 50 percent in North Carolina (1.7 percent annually) and 28 percent in South Carolina (0.9 percent annually) overall by 2030, and SERC regional data, which is estimating growth in power demand of approximately 1.4 percent as discussed in Section 8.1.

8.2.1.4 Energy Efficiency and Demand-Side Management

Duke offers a full suite of residential and non-residential EE and DSM programs. Accordingly, the IRP identifies, quantifies, and embeds existing EE and DSM programs into the current forecast. In compliance with a NCUC requirement, Duke will be allocating 1 percent of annual retail revenue from the sale of electricity on future conservation and demand response programs in addition to programs already implemented (Duke 2012a). Examples include programs providing financial incentives to install energy-efficient equipment and technologies, weatherization, and insulation and implement programs that provide technical assistance and educational materials to assist customers in conserving energy. Duke also offers several DSM programs to its customers to reduce peak electricity demands. The effects of these DSM programs are included in the forecast for net system requirements and summer peak load assessments.

In May 2007, Duke filed a specific *Energy Efficiency Plan* in North Carolina (Duke 2007d - Docket No. E-7, Sub 831) and South Carolina proposing the implementation of up to 1700 MW(e) of energy-reduction programs across the region of interest by 2012. The plan has been vetted through the NCUC and PSCSC hearing processes and has been adjusted to reflect a target baseline goal of up to 1900 MW(e) of energy and peak reduction programs over the next 20 years. The 2012 IRP load forecast includes over 1200 MW(e) of cumulative DSM programs, 1320 MW(e) of new EE programs, and a target of a reduction of up to 9.2 million MWh (Duke 2012a).

8.2.1.5 Regional Sharing and Reserve Margin

As a member of the VACAR subregion of SERC, Duke participates in a reserve sharing agreement. This agreement with other members of VACAR requires Duke to carry a proportional share of reserve capacity equal to 1.5 times the capacity of the largest generating unit. This is currently equal to a reserve capacity of 1700 MW(e) and ensures compliance with SERC reliability standards. In addition to its reserve sharing agreement as a member of VACAR, Duke uses a 15.5 percent target planning reserve margin for long-term planning. The SERC region Duke operates in does not require reserve margins; rather, members rely on respective State utility commission directives regarding maintenance of adequate resources. The NCUC requires utilities to include justification of the reserve margin used for planning purposes; the NCUC has approved Duke's stated reserve margin every year via approval of the IRP. Duke has also presented its 15.5 percent reserve margin and reserve margin justification for planning purposes to the PSCSC each year, either through the IRP or annual update. Most recently, Duke has completed a reserve margin analysis based on the NCUC Public Staff's comments provided to the NCUC regarding the 2010 IRP indicated that Duke had not conducted a comprehensive study to determine the appropriate reserve and capacity margin values in a number of years, and that a full reserve margin analysis should be conducted as soon as practicable with subsequent filings to incorporate the analysis. The NCUC Public Staff further commented that

> "The studies should determine the optimal level of reserves to provide generation reliability that considers, the obligation to serve, the value of electricity, and the effect of outages (unserved load), while minimizing the cost to ratepayers" (NCUC 2011c).

It is noted that even if the comprehensive reserve margin analysis should indicate a lower reserve margin is reasonable for future planning, it is not expected to impact the need for baseload capacity. This was corroborated by the NCUC Public Staff in its investigation of the impacts of incorporating a 14 percent target reserve margin into Duke's reference case; the lower reserve margin resulted only in "largely eliminating the need for a 370 MW(e) of combustion turbine" (NCUC 2011c). Based on the findings of the analysis, Duke found that a target reserve margin of 14 to 16 percent performed well in most sensitivity cases. Carried forward, Duke uses 15.5 percent reserve margin for planning purposes (Duke 2012a).

8.2.2 Demand Forecast

The following is a summary of the electricity demand forecast for Duke, including implemented EE programs. The forecasted cumulative demand is evaluated for 2027, which would represent 3 years of commercial operation of both proposed units referenced to the 2012 IRP. The analysis accounts for all currently known demand-side resources as provided through utility IRPs, as docketed and reviewed by each respective State's utility commission. The following analysis provides the projected demand for capacity. The final demand and supply analysis is provided in Section 8.4.

Based on preceding information and Table 8-2, the NRC staff confirmed that the conclusions are acceptable as reviewed, verified, and approved by each respective State's utility commission, NCUC Public Staff (North Carolina), and PSCSC Office of Regulatory Staff (South Carolina). The demand for electricity, including reserve margin, is forecasted to be 26,416 MW(e) in the timeline of consideration.

Table 8-2. 2027 Demand for Power

	Duke IRP Forecasted Demand (MW(e))
Firm peak demand[a]	22,871
Reserve[b]	3545
Final electricity demand for the service territory	26,416

(a) Firm peak less new EE programs (Duke 2012a).
(b) State-approved operating reserve margin (15.5 percent).

8.3 Power Supply

This section discusses the expected supply of electricity in the Duke service area that would be available 3 years after full operation of both proposed units. In developing the power-supply and capacity forecasts for its respective service area, Duke factored in its present- and planned-generating capabilities, present and planned purchases and sales of power, distributed and self-generation power sources, and demand-side reduction.

8.3.1 Present and Planned Generating Capability

The reliable supply of power is inherent to Duke's legal obligations in North Carolina and South Carolina. Accordingly, each State's public utility commissions annually review the power-demand and power-supply forecasts, as well as supporting documentation that may materially affect the forecasting accuracy and power-supply requirements (i.e., Renewable Energy Portfolio Standards [REPS]). As a power generator, Duke is engaged in the operation of baseload, intermediate, and peaking duty power plants. Duke estimates that of the cumulative 21,044 MW(e) of summertime capacity forecasted in 2013, baseload capacity in the form of nuclear and coal-fired facilities will supply approximately 62 percent of the total capacity required and 84 percent of the energy produced (Duke 2012a). The remainder of the capacity requirements will be met by resources such as intermediate and peaking duty power plants, power purchases, and other power supplies such as hydropower and distributed-generation-type facilities.

By annually reviewing and adjusting capacity resources over a rolling 20-year planning period, Duke is able to account for new capacity, unit retirements, generating capacity up-rates and de-rates, as well as impacts of policy drivers (such as the 2007 State of North Carolina Renewable Energy and Energy Efficiency Portfolio Standard) on the resource mix. From this, multiple resource portfolios are generated and tested against cumulative capacity requirement projections and combinations of forecast sensitivities. The resource portfolios do not specify preference or partiality for capacity type; rather they provide a systematic analysis of a range of potential capacity resources necessary for the development of a balanced and cost-effective resource portfolio.

Duke is currently engaged in several activities that will serve to provide additional capacity within the timeline of consideration. The activities are modeled annually on a rolling 20-year planning horizon enabling the incorporation of the most recent and updated information such as receiving a final ruling from the South Carolina for a CPCN for the addition of new generating capacity. Duke's current activities include the development of new fossil-fired capacity (e.g., Cliffside power plant), the Buck Combined Cycle and Dan River Combined Cycle projects, upgrading of hydro-based power plants (Duke 2012a), and potentially increasing its ownership stake in a regional nuclear station through the purchase of capacity (Duke 2012a). Collectively, all of these activities are subject to jurisdictional review and approval from applicable regulatory bodies (e.g., the State utility commissions and FERC).

Duke engages in the annual review and revision of decision dates for unit retirements. These comprehensive evaluations incorporate unit-specific and system-wide goals pertaining to reliability and cost of operation and are coupled with evaluations measuring the effective implementation of demand-reduction and environmental strategies. Duke is currently proposing to retire over 1000 MW(e) of generating assets and potentially up to 1450 MW(e); however, some older coal-fired units may be converted to natural-gas-fired units (Duke 2012a). These retirements are all fossil-fuel-based facilities consisting primarily of combustion turbines and older coal-fired units.

The 2012 Duke IRP quantifies the need for additional capacity well in excess of the capacity expansions already approved by the State via the CPCN process and well in excess of the capacity of the proposed project. By 2028, which is the timeline of consideration as described in Section 8.2.2, Duke is anticipating a need for 4820 MW(e) to meet the growth in future demand, which includes a 15.5 percent planning reserve margin (Duke 2012a). Of that 4820 MW(e), the proposed project is intended to provide slightly less than 50 percent, with the remainder of capacity needs relying on the timely development of combined-cycle power plants, EE, and renewable energy sources (Duke 2012a).

8.3.2 Present and Planned Purchases and Sales of Power

In addition to the sales and delivery of power to the franchised service territory, Duke is an active participant in the wholesale power market for both the sale and purchase of capacity. Duke maintains wholesale power sales agreements with Rate Schedule 10A customers such as municipalities and universities, electric membership cooperatives, and customers with backstand agreements for capacity. In its 2012 IRP, Duke indicates that it will maintain between 900 and 2100 MW(e) of wholesale power sales contracts over the next 10 years (Duke 2012a).

Duke also satisfies a portion of the resource portfolio by routinely purchasing capacity through power purchase agreements. This has historically included contracted power purchase agreements from conventional non-utility (merchant) units such as natural gas-fired combustion turbines and combined-cycle plants, as well as capacity from renewable energy generators and small cogeneration facilities. In its 2012 IRP, Duke indicated that it had firm wholesale purchase commitments for approximately 300 MW(e) of capacity from such facilities (Duke 2012a). Additional power purchases are expected to include conventional energy supplies for intermediate and peaking capacity. As an example, Duke issued bid requests for up to 800 MW(e), with future bid requests (2013 and beyond) of up to 2000 MW(e) (Duke 2012a) when resource needs were identified in previous planning exercises. The market-based bid responses were compared to Duke self-build options, and evaluated as part of the NCUC’s CPCN proceedings regarding the Buck Combined Cycle and Dan River Combined Cycle projects. Though Duke ultimately chose to build rather than purchase the capacity, the formal CPCN process ensured appropriate consideration was afforded the purchased-power options.

Guided by the recently enacted North Carolina REPS plan, Duke has issued several rounds of requests for proposals (RFPs) with expressed intent to increase its renewable energy portfolio. The original 2007 RFP process provided a proposed 1900 MW(e) of capacity from alternative energy sources such as wind, solar, biomass, and other sources. The 2012 IRP indicates that renewable energy sources are expected to contribute 758 MW(e) to summer on-peak capacity requirements over the next 20 years (Duke 2012a).

8.3.3 Distributed and Self-Generation of Power

In support of Federal and State policies, Duke routinely purchases capacity from qualifying facilities as designated by the Public Utility Regulatory Policies Act of 1978. Though these facilities are individually of limited total capacity, taken collectively they provide a useful resource for capacity and are included in the Duke's power supply resource mix and load forecasts. Additional resources include smaller, customer-owned standby generation sources that participate in the customer standby generation program; these are also included in both Duke's power supply resource mix and load forecasts. The capacity from these facilities is reflected in the annual load forecast as purchased capacity or as future renewable resource additions.

8.3.4 Need for Baseload Capacity

In concurrent State-approved IRPs and in CPCN hearing records, the NCUC Public Staff (North Carolina) and PSCSC Office of Regulatory Staff (South Carolina)found adequate evidence that the Duke service area will be reasonably served by a balanced resource portfolio that includes the development and integration of multiple sources of energy including traditional power generation resources such as baseload, intermediate, and peaking power supply; programs targeting the expansion of renewable energy resources; and EE and DSM plans (Duke 2012a). Duke has presented its proposed need for new capacity as part of its annual forecast. As evaluated for the hearing record, the IRP indicates that when tested against a variety of sensitivities and planning scenarios (pricing, environmental, regulatory), growing customer demand will be met by the integrated development of baseload, intermediate, and renewable resources; as well as EE and DSM (Duke 2012a).

The SERC Reliability Review Subcommittee (RRS), which conducts seasonal and annual reliability assessments of the SERC region by reviewing the data and studies submitted by SERC member systems, reported in its 2012 Annual Report that while near-term[a] planning horizons appear to indicate sufficient capacity resources, adequate long-term[b] planning reserves would be dependent on future business decisions, including the utilization of uncommitted generation and construction of new baseload capacity (SERC 2012). The RRS also recognizes that, based on the percentage of planned net capacity additions, utilities are preparing to meet the growth in demand, as well as retirements, with a significant commitment to low-carbon-capacity resources (e.g., natural-gas-fired generation [near term] and nuclear

(a) Represented as years present through 2016 (SERC 2012).
(b) Represented as years 2016 through 2021 (SERC 2012).

[long term]) (SERC 2012). As discussed in Sections 8.1.2 and 8.3.2, the NRC staff confirmed it is not reasonable for Duke to pursue uncommitted capacity to satisfy long-term baseload capacity requirements, and the generating capacity that is available is largely natural-gas-fired generation. Accordingly, the NRC staff finds that the proposed project is consistent with a SERC RRS-recognized baseload-generating alternative.

Additional language supporting the need for baseload capacity in the region is provided in the South Carolina State Regulation of Public Utilities Review Committee's Energy Policy Report, which is a comprehensive accounting of both the current and future energy requirements in South Carolina. Although produced largely in the context of addressing pending Federal energy policies and establishing strategies for a course of action, the report, which was compiled by the Office of Regulatory Staff and included a full public vetting, recognized that South Carolina has a "growing baseload electric need" (PURC 2009).

8.3.5 Supply Forecast

The following is a summary of the forecasted cumulative supply for the Duke service territory. The forecasted cumulative supply is evaluated for 2027, which would represent 3 years of commercial operation of both proposed units referenced to the 2012 IRP. The analysis accounts for all currently known and approved supply-side resources as provided through Duke's IRP.

The NRC staff confirmed the PSCSC and NCUC determination that the cumulative generating capacity as offered in the IRP represented a reasonable baseline for the analysis of the supply of power in the service area. Line 8 of Duke's Summer Projections of Load, Capacity, and Reserves table, indicates that existing capacity in 2027 would be 20,207 MW(e). In consideration of company and State-level objectives, the NRC staff assumes that all renewable energy capacity and DSM would be installed, purchased, or utilized; therefore, the NRC staff assumed the full implementation of renewable energy programs (Line 12), would provide an additional 684 MW(e) of capacity and full implementation of DSM programs (Line 17) would provide an additional 1207 MW(e) of capacity. The NRC staff determined that a total cumulative capacity of 22,098 MW(e) would be available to serve load in 2027 (Duke 2012a). Table 8-3 provides the electricity cumulative supply forecast for the Duke service area through summer of 2027 (Duke 2012a). A final demand and supply analysis is provided in Section 8.4.

Based on the preceding information, the NRC staff forecast that the cumulative equivalent capacity will be approximately 22,098 MW(e) in 2027.

Table 8-3. 2027 Cumulative Supply of Power

	Forecasted Cumulative Supply (MW) in 2027 Including Full DSM Implementation and Renewable Resource Additions
1. Cumulative generating capacity[a]	20,207
2. Plus full renewables future additions[b]	684
3. Plus full DSM program implementation[c]	1207
Total cumulative capacity	22,098

Source: Duke 2012a
(a) Line 8, pg. 93
(b) Line 12, pg. 93
(c) Line 17, pg. 93

8.4 Assessment of the Need for Power

The NRC staff considered the hearing record and ensuing evaluations of the Duke 2010, 2011, and 2012 IRPs, as well as other energy forecasts to develop a conclusion about the need for power. The NCUC issued its final orders approving the 2010 and 2011 IRPs in October 2011 and May 2012, respectively. The orders are the State's indications to Duke that the IRPs are compliant with all applicable regulations and directives and, further, provide an explanation of the proceedings, conclusions, and direction for future IRPs. The NCUC approved Duke's summer reserve margin of 15.5 percent for planning forecasts and its forecast planning methodology, which included sensitivities to load forecasting and forecast uncertainty. Duke demonstrated that significant capacity additions would be required within the stated timeline of the proposed project to maintain the target planning reserve margin. The analysis included projections both with and without fully implemented demand-side programs; in both cases, summer peaking load placed planning reserve margins well below target. Duke further specified and offered as part of the IRP that it intends to make baseload capacity additions a significant contributor to the future need for power (NCUC 2012a).

Utility commissions in North Carolina and South Carolina have supported the identified need for new capacity resources and have formalized that position by determining that it is reasonable for Duke to incur limited project costs to preserve the nuclear generation development option (NCUC 2011d), and PSCSC (2011a). Since 2005, each Duke IRP, or annual update, has included an analysis of the nuclear generation option. Consistent with planning objectives conducted on an annual basis and disclosed to the States, Duke disclosed in their 2012 IRP that they anticipate commercial operation of the first nuclear generating unit in 2022, with the second unit planned to be operational in 2024.

As discussed previously, though the 2013 IRP forecast moved the in-service dates to 2024 and 2026 respectively, review of the forecasted data indicates that this does not materially impact the overall need for power requirement quantified in the following Section 8.4.2.

8.4.1 Other Forecasts for Energy

Outcomes of the forecasting efforts are subject to confirmation by parties external to Duke, such as the NCUC Public Staff, PSCSC Office of Regulatory Staff, State utility commissions, state energy offices, and the SERC RRS. Load forecasts submitted by the utilities operating within SERC are a critical element of the process used to establish the capacity obligations within SERC. Therefore, the load forecast receives considerable scrutiny from the SERC RRS to ensure that it represents a reliable estimate of future peak loads and provides the basis upon which to evaluate future capacity requirements. The RRS annual report captures those forecasts and provides a documented assessment, ensuring that the SERC region is being planned in accordance with the NERC reliability standards and applicable SERC supplements (SERC 2012). The predictive capability of Duke's load forecast has compared favorably to historic forecasts and analyses of the VACAR subregion found in RRS annual reports to the SERC's engineering committee.

8.4.2 NRC Conclusions

The NRC staff reviewed the Duke 2010, 2011, and 2012 IRPs; the evaluation conducted by the State of North Carolina via the NCUC Public Staff and the State of South Carolina via the PSCSC Office of Regulatory Staff; and the need for power contained therein within the context of the guidelines in the NRC's ESRP and supplemental guidance (NRC 2000a) as detailed in Section 8.1.4. The NRC staff determined that Duke submitted a comprehensive power-supply and demand forecast to the NCUC and PSCSC that contained a detailed review of the need for power in the Duke service area of North Carolina and South Carolina and effective surrounding geography. Where applicable, supporting details from the NERC, SERC, and the VACAR subregion were used to validate the findings of the States. The NRC staff concluded that the States evaluation of Duke's future load demand and Duke's accuracy in historical load forecasting was a reasonable basis for planning. The NRC staff also verified that Duke's IRPs are (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty.

Duke has indicated that to maintain its regulatory responsibilities, future capacity additions must include significant contributions from all types of supply-side and demand-side resources. The IRP incorporates planned capacity additions representing baseload, intermediate, and peaking duty technologies, in addition to significant contributions from renewable resources, DSM, and EE programs. While a significant percentage of the need for power will be satisfied by the full implementation of DSM and new renewable energy resources, it is reasonable to conclude that the remainder of the capacity requirements must be met by new generating capacity. Table 8-4 provides the NRC staff's final analysis of the cumulative need for power.

Table 8-4. Final Analysis of the Cumulative Need for Power in 2027

	Cumulative Need for Power MW(e)
Cumulative demand including reserve margin	26,416
Cumulative supply including full DSM and renewables	22,098
Total new capacity required	4318

The NRC staff determined that the cumulative need for power is 4318 MW(e) in 2027. In consideration of the States' evaluation, approval, and determination of the need for power for Duke, the NRC staff accepts as complete and adequate the need-for-power evaluation contained in States' evaluation of the IRP.

9.0 Environmental Impacts of Alternatives

This chapter describes alternatives to the proposed U.S. Nuclear Regulatory Commission (NRC) action for combined licenses (COLs) and the U.S. Army Corps of Engineers' (USACE's) action for a Department of the Army individual permit and discusses the environmental impacts of those alternatives. Section 9.1 discusses the no-action alternative. Section 9.2 addresses alternative energy sources. Section 9.3 reviews the region of interest (ROI) evaluated in the site-selection process, the Duke Energy Carolinas, LLC (Duke) site-selection process, details specific to each one of the respective alternative sites, and summarizes and compares the cumulative environmental impacts for the proposed and alternative sites. Section 9.4 examines plant design alternatives. Section 9.5 presents the USACE's evaluation of onsite alternatives and alternative sites.

The need to compare the proposed action with alternatives arises from the requirement in Section 102(2)(c)(iii) of the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. 4321) that environmental impact statements (EISs) include an analysis of alternatives to the proposed action. The NRC implements this requirement through its regulations in Title 10 of the *Code of Federal Regulations* (CFR) Part 51 and its Environmental Standard Review Plan (ESRP) (NRC 2000a). The environmental impacts of the alternatives are evaluated using the NRC's three-level standard of significance – SMALL, MODERATE, or LARGE – developed using Council on Environmental Quality (CEQ) guidelines (40 CFR 1508.27) and set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. The issues evaluated in this chapter are the same as those addressed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), Revision 1 (NRC 2013a). Although the GEIS was developed for license renewal, it also provides useful information for the review of new reactors, and is referenced where appropriate throughout this chapter. Additional guidance on conducting environmental reviews is provided in the Staff Memorandum on "Addressing Construction and Preconstruction, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statements" (Revision 1) (NRC 2011a).

As part of the evaluation of permit applications subject to Section 404 of the Clean Water Act, the USACE is required by regulation to apply the criteria set forth in the U.S. Environmental Protection Agency's (EPA's) 404(b)(1) guidelines (40 CFR Part 230; hereafter referred to as the 404 Guidelines). These guidelines establish criteria that must be met for the proposed activities to be permitted pursuant to Section 404, which governs disposal sites for dredged or fill material. Specifically, the 404 Guidelines state, in part, that no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge that would have less adverse impacts on the aquatic ecosystem provided the alternative does not have other significant adverse consequences. An area not presently owned by the applicant that could reasonably be obtained, used, expanded, or managed to fulfill the basic purpose of the proposed activity may be considered if it is otherwise a practicable alternative.

9.1 No-Action Alternative

For purposes of an application for COLs, the no-action alternative refers to a scenario in which the NRC would deny the COLs requested by Duke. The USACE could also take no action, or deny the applicant's request for a Department of the Army permit. Upon such a denial by the NRC, the construction and operation of two new nuclear units at the William States Lee III Nuclear Station (Lee Nuclear Station) site in accordance with 10 CFR Part 52 would not occur and the predicted environmental impacts associated with the project would not occur. Preconstruction impacts without a nexus to nuclear safety issues regulated by the NRC, as defined in 10 CFR 50.10(a) and 51.4, may still occur, and environmental impacts resulting from preconstruction activities could still result, even if the NRC denies the COLs requested by Duke. However, no activities, including preconstruction activities, involving discharge of dredged or fill materials into waters of the United States, could occur without a Department of the Army permit from the USACE.

The no-action alternative would result in the proposed nuclear units not being constructed or operated. If no other comparable energy-generation facility (or facilities) was built or strategy implemented to take its place, the benefits of the additional electrical capacity and electricity generation provided by the proposed project would not occur. If no additional conservation measures were enacted to decrease the demand for electrical capacity in Duke's service territory, then the need for baseload power, discussed in Chapter 8, would not be met. Therefore, the purpose and need for this project would not be satisfied by the no-action alternative.

If other generating sources were built, either at another site or using a different energy source, environmental impacts associated with these other sites or energy sources would result. As discussed in Chapter 8, there is a demonstrated need for power and Duke has regulatory responsibilities in North Carolina and South Carolina to provide electrical service in its service area. This needed power may be provided and supported through a number of alternatives that are discussed in Sections 9.2 and 9.3. Therefore, this section does not include a discussion of alternative energy sources (discussed in Section 9.2) or alternative sites (discussed in Section 9.3) that could meet the need for power.

9.2 Energy Alternatives

The purpose and need for the proposed NRC action (i.e., issuance of COLs) identified in Section 1.3.1 of this EIS is to provide additional baseload electric generating capacity within the

Duke service territory by 2024 and 2026[(a)] (Duke 2013b). This section examines the potential environmental impacts associated with energy management or generation alternatives to construction and operation of a new baseload nuclear generating facility (whether at the Lee Nuclear Station site or elsewhere). Section 9.2.1 discusses energy alternatives not requiring new generating capacity. Section 9.2.2 discusses energy alternatives requiring new generating capacity. Other energy alternatives are discussed in Section 9.2.3. A combination of energy alternatives is discussed in Section 9.2.4. Section 9.2.5 compares the environmental impacts from new nuclear, coal-fired, and natural-gas-fired generating units at the Lee Nuclear Station site. Additionally, Section 9.2.5 considers a combination of energy alternatives located at the Lee Nuclear Station site or within close proximity to the Duke service territory.

For analysis of energy alternatives, Duke assumed a bounding target value of 2200 megawatts electric (MW[e]) of electrical output, which is the approximate equivalent electrical capacity of the proposed Lee Nuclear Station project. The review team also used this level of output in its analysis of energy alternatives.

9.2.1 Alternatives Not Requiring New Generating Capacity

The following are three alternatives to the proposed action that do not require Duke to construct new generating capacity:

- purchase the needed electric power from other suppliers
- extend the operating life of existing power plants or reactivate retired power plants
- implement energy efficiency (EE) or demand-side management (DSM) programs.

These alternatives are reviewed in the following sections.

9.2.1.1 Purchased Power

Power to replace the capacity of the proposed new nuclear units would have to be purchased from other generating resources. Under the purchased power alternative, the environmental impacts of power production would still occur but would likely be located elsewhere within the Southeastern Electric Reliability Council (SERC) region, or in neighboring regions with direct bulk transmission capability into the SERC.

The option to purchase power implies that there is adequate generating capacity available for firm sales and transmission into or within the service territory, and Duke regularly reviews

(a) On October 15, 2013, Duke Energy Carolinas submitted its 2013 Integrated Resource Plan (IRP) to the North Carolina Utilities Commission. In this document Duke modified the in-service dates for the two units to 2024 and 2026 and adjusted its projections for future generation sources. Because the review team determined that the changes in the updated IRP do not materially change the analysis or its results, the analysis that follows has not been modified to address the 2013 IRP.

purchased power supply options. Duke reported most recently that it had entered into purchased power arrangements for over 2000 MW(e) over the past 10 years (Duke 2012a).

Utility commissions in both North Carolina and South Carolina have commented on the potential ramifications of requiring capacity purchases. While additional regional capacity may be available to serve native loads from merchant power plants or other similar generators, the capacity from these plants is not generally considered to be useful in supplying baseload capacity. This premise was confirmed by Public Service Commission of South Carolina (PSCSC) Order 2007-626, which indicated that the risk to low-cost, reliable electricity increased in magnitude as mandatory requests for proposals (RFPs) were applied to peaking, intermediate, and ultimately baseload capacity requirements. The Order further concluded that testing the market via RFPs would only be mandatory for new peaking capacity needs (PSCSC 2007). The North Carolina Utility Commission (NCUC), in its order approving the Duke 2005 Integrated Resource Plan (IRP) (NCUC 2006) indicated that,

> During periods of peak consumption, the state's utilities might have to pay extremely high rates to purchase power from other utilities; in some cases they may be unable to import sufficient power at all because of the limitations of the transmission system or for other reasons.

The review team recognizes that the Lee Nuclear Station site is in South Carolina. However, the review team also recognizes the proximity of the site to North Carolina and the fact that the site lies within one contiguous Duke service area, of which the highest percentage of delivered power is used in North Carolina.

Finally, under the Public Utility Regulatory Policies Act of 1978 (PURPA), electric utilities can offer the purchase of electrical energy from qualifying facilities. Due to the limited number and limited total available capacity of PURPA-qualifying facilities in the area, they do not represent a long-term solution for additional baseload capacity in the Duke service territory.

Based on the preceding discussion and the information in Section 8.3.2, which details the Duke power purchasing strategy, the review team concludes that purchasing power is not a reasonable alternative to providing new additional baseload capacity commensurate with the proposed project.

9.2.1.2 Extending the Service Life of Existing Plants or Reactivating Retired Plants

Nuclear power stations are initially licensed by the NRC for a period of 40 years. An operating license can be renewed for up to 20 years, and NRC regulations permit additional license renewals. The NRC performs detailed safety and environmental reviews that comply with the Atomic Energy Act and NEPA prior to each renewal. Duke operates three nuclear power stations in the service area: Catawba Nuclear Station Units 1 and 2 and Oconee Nuclear

Station Units 1, 2, and 3 in South Carolina, and McGuire Nuclear Station Units 1 and 2 in North Carolina. The operating licenses for all three nuclear power stations have been renewed: Oconee Nuclear Station Units 1, 2, and 3 in May 2000 and McGuire Nuclear Station Units 1 and 2 and Catawba Nuclear Station Units 1 and 2 in December 2003 (NRC 2012a). The environmental impacts of continued operation of a nuclear power plant are substantially less than those of developing a new plant. Though existing nuclear stations can receive power uprate licenses from the NRC, the largest capacity increase that the NRC has approved has been 20 percent (NRC 2003).

Fossil fuel-fired power plants slated for extensive refurbishment or reactivation, predominately fossil-fired power plants, generally have economic difficulty meeting the current, more restrictive environmental standards established under the Clean Air Act and Clean Water Act. There are a significant number of planned generating unit retirements within the proposed time frame of the Lee Nuclear Station construction schedule. Several of the retirements are contingent upon the availability of newer generating assets such as the proposed new 825-MW(e) clean-coal Unit 6 at the Cliffside Steam Station in North Carolina. Additionally, Duke indicates that it has included over 2000 MW(e) of conventional coal and combustion turbines on the planned unit retirement list that might be considered for refurbishment. These units lack scrubbing equipment used to remove sulfur emissions or face other environmental regulatory restrictions that would require increased control, accelerating the retirement of 890 MW(e) by 2015 (Duke 2012a). The reactivation of any fossil-fired facility would be bound by the impacts described for the coal and natural-gas-fired alternatives in Section 9.2.2, and would have to comply with the most recent environmental restrictions. As neither coal nor natural-gas-fired alternatives are found to be environmentally preferable to the proposed action, the review team concludes that refurbishment or reactivation of fossil-fired facilities is not a reasonable alternative to proposed action.

Duke owns and operates over 1000 MW(e) of hydroelectric generating facilities within the service territory in addition to significant pumped-storage capacity (Duke 2012a). Licensing and relicensing activities are conducted pursuant to the Federal Power Act and administrated by the Federal Energy Regulatory Commission (FERC). Though uprating capacity is possible, continued operation of existing hydroelectric generation facilities does not necessarily result in providing additional generation capacity. A significant percentage of Duke's hydroelectric capacity is currently operating under the FERC Notice of Authorization for Continued Project Operation for Project No. 2232-522 (73 FR 55505). This process enables the licensee (Duke), to continue uninterrupted hydroelectric operations in accordance with the terms and conditions of the previous license, until the FERC acts on the subsequent application for continued operations, or provides orders directing future activities. While the eventual relicensing of the affected facilities may serve to allow the continued operations of existing capacity, it is not expected to increase capacity. Further, if the project is not relicensed, the loss of capacity would increase the need for power as described in Section 8.4. Discussion of additional hydroelectric capacity is provided in Section 9.2.3.4.

Based on the above discussion, the review team concludes that extending the operating life of existing power plants and reactivating or refurbishing retired plants would not provide additional baseload capacity commensurate with the proposed project and therefore is not a reasonable alternative to the proposed project.

9.2.1.3 Energy Conservation

The aggressive implementation of EE programs is effective in reducing total energy requirements, while DSM programs are effective in reducing peaking and intermediate generation capacity requirements. This is reiterated by North Carolina's Senate Bill 3, which specifically defines DSM as "activities, programs or initiatives undertaken…to shift the timing of electric use from peak to nonpeak demand periods" and EE measures as "an equipment, physical or program change that results in less energy used to perform the same function" (NCUC 2010c).

Duke currently uses comprehensive EE and DSM programs to reduce peak electricity demands and daily power consumption. As reviewed in Section 8.2.1, Duke has proposed to collectively account for almost 2400 MW(e) of EE and DSM out to 2032. Current energy forecasts and load growth projections fully account for the EE and DSM programs, which have been reported as part of the 2012 IRP forecasting process. The programs were vetted through the public hearing process with the NCUC issuing a final settlement agreement approving the program (NCUC 2010d) and the PSCSC via Order No. 2010-79 (PSCSC 2010c). The proposed EE and DSM programs represent a significant reduction in demand for both energy and peak power. However, because the current forecast already accounts for their implementation, and because Duke still demonstrates a significant need for power as described in Section 8.4, they do not represent a substitute for the additional capacity that Duke is seeking through the proposed project. Therefore, EE and DSM programs are not a reasonable alternative to the proposed project.

9.2.1.4 Conclusions

Based on the preceding considerations, the review team concludes that purchasing electric power from other suppliers, reactivating retired power plants, extending the operating life of existing power plants, and full implementation of additional EE and DSM programs are not reasonable alternatives to providing new baseload power generation capacity to meet the long-term requirements in the service territory.

9.2.2 Alternatives Requiring New Generating Capacity

This section discusses the environmental impacts of energy alternatives to the proposed action that would require the applicant to build new generating capacity. In keeping with the NRC staff's evaluation of alternatives to renewal of operating licenses, a reasonable set of energy alternatives to the building and operation of one or more new nuclear units at the Lee Nuclear Station site should be limited to analysis of those power-generation technologies that are technically reasonable and commercially viable, and capable of supplying an equivalent amount of power at a capacity factor similar to a nuclear power plant (NRC 2013a). The discussion in this section is bounded by the individual power generating alternatives that are considered reasonable and viable as baseload technologies. As described in Chapter 8, baseload designed power in the State of South Carolina is defined as being capable of operating at a capacity factor greater than 70 percent, and exceeding 350 MW(e) (SC Code Ann. 58-33-220). The current mix of power-generation options within the SERC is also an indicator of the feasible choices for power-generation technology; approximately 77 percent of the current fleet within the SERC region is fossil-fired generation, followed by nuclear at 14 percent, hydro (including pumped storage) at 8 percent, with the remainder at approximately 1 percent (SERC 2013).

Each year, the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an annual energy outlook. In the *Annual Energy Outlook 2011* (DOE/EIA 2011), the EIA reference case projects that between 2010 and 2035, natural-gas-fired capacity would account for approximately 60 percent of new capacity additions; renewable energy sources would account for approximately 25 percent of new capacity additions; coal-fired capacity would account for approximately 11 percent of new capacity additions; and new nuclear plants would account for approximately 3 percent of new capacity additions (DOE/EIA 2011).

The review team recognizes that proponents of all of these generating resources are continually working to develop improved technologies that are more cost efficient and result in fewer environmental impacts, and the impacts discussed below are estimates based on present technologies. However, the discussion in Sections 9.2.2.1 and 9.2.2.2 is limited to the individual alternatives that appear to the review team to be viable baseload generation sources of a commensurate level of power as the proposed project: coal-fired and natural-gas combined-cycle-fired generation. The discussion in Section 9.2.3 addresses alternative generation technologies that have demonstrated commercial acceptance but may be limited in application, total capacity, technical feasibility, or geographic restrictions when compared to the need to supply reliable, baseload capacity.

The review team assumed new generation capacity would be located at the Lee Nuclear Station site for the coal-fired and natural-gas-fired alternatives, and mechanical draft cooling towers would be used. For completeness, the electric power transmission-line rights-of-way from these alternatives were assumed to follow the same rights-of-way proposed for nuclear generation on the Lee Nuclear Station site. These rights-of-way, as previously discussed, would be developed to tie in to the 230-kV Pacolet Tie-Catawba transmission line approximately 7 mi south of the Lee Nuclear Station site, and the 525-kV Oconee-Newport transmission line approximately 15 mi south of the site.

9.2.2.1 Coal-Fired Power Generation

For the coal-fired generation alternative, the review team assumed building and operation of four pulverized coal-fired units, each with a net capacity of 530 MW(e) at the Lee Nuclear Station site for a gross capacity of 2120 MW(e). The review team also assumed the acquisition and use of the same transmission-line rights-of-way, discussed for the proposed Lee Nuclear Station in Section 3.2.2.3, as well as development and operation of Make-Up Pond C, which would be required based on using the same electrical generating technology as the proposed project (condensing steam turbine). The new coal-fired generation is assumed to have an operating life of 40 years (the same operating life as allowed initially for a nuclear plant under a COL, even though that number has no regulatory applicability to non-nuclear power plants).

The review team also considered integrated gasification combined-cycle (IGCC) coal-fired power plants as a baseload-capable technology. IGCC is an emerging technology for generating electricity with coal that combines modern coal gasification technology with combustion-turbine and steam-turbine power generation. This technology is considered to be cleaner than conventional pulverized coal plants because major pollutants can be removed from the gas stream before combustion. The IGCC alternative also generates less solid waste than the pulverized coal-fired alternative. The largest solid-waste stream produced by IGCC installations is slag, a black, glassy, sand-like material that is a marketable byproduct. The other large-volume byproduct produced by IGCC plants is sulfur, which is extracted during the gasification process and can be marketed rather than placed in a landfill. IGCC plants do not produce ash or scrubber wastes. Duke Energy Indiana received regulatory approval to construct a 630-grossMW(e) power station at the existing Edwardsport site in Indiana. The Edwardsport project has the advantage of local, State, and Federal incentives totaling $460 million (Duke Energy 2011b).

Although IGCC has the advantages noted above, the review team concludes that, at present, IGCC is not a reasonable alternative to a 2200-MW(e) nuclear power-generation facility for the following reasons: (1) IGCC plants are more expensive than comparable pulverized coal plants; (2) the system availability of existing IGCC plants has been lower than pulverized coal plants (NETL 2007); (3) and refined engineering has indicated that non-carbon emissions and plant efficiency would not be significantly better than supercritical steam electric plants (NPCC 2010). For these reasons, IGCC plants are not considered further in this EIS.

Air Quality

The review team assumed a plant design that would minimize air emissions through a combination of boiler technology and post-combustion pollutant removal. Emission estimates are based on “as-fired” and controlled conditions and are not representative of what would likely be permitted. Final permitting to operate the plant would require applicable Best Available Control Technologies (BACT) as part of the new source review requirements under Title 1 of the Clean Air Act. Impacts on air quality from coal-fired generation would vary considerably from those of nuclear generation because of emissions of criteria pollutants from sulfur dioxide, nitrogen oxides, carbon monoxide, particulate matter, and hazardous air pollutants such as mercury.

Duke (2009c) provided the following emissions estimates for the coal-fired alternative for sulfur dioxide (SO_2), nitrogen oxides (NO_x, including NO and NO_2), carbon monoxide (CO), and total particulate matter (PM), with the review team concluding that the estimates were reasonable for the technology and controls selected:

- SO_2 – 7814 T/yr
- NO_x – 1658 T/yr
- CO – 1658 T/yr
- PM_{total} – 64 T/yr
- PM_{10} (particulate matter with an aerodynamic diameter of 10 microns or less) – 17 T/yr.

In addition, a coal-fired power plant would have carbon dioxide (CO_2) emissions of approximately 19,000,000 T/yr, which could contribute to climate change (Duke 2009c). Further discussion regarding CO_2 is found in Section 9.2.5.

Coal and limestone (calcium carbonate) for a pulverized coal-fired plant would be delivered to the site by train. The review team assumes that the coal and limestone could be delivered using the same railroad spur proposed to service Lee Nuclear Station Units 1 and 2. The plant is expected to consume approximately 6.6 million T/yr of pulverized bituminous coal with ash content of 9.8 percent (Duke 2009c). Lime or limestone slurry is injected into the hot effluent combustion gases to remove entrained SO_2. The lime-based scrubbing solution reacts with SO_2 in the flue gas to form calcium sulfite or calcium sulfate, which precipitates and forms sludge. The sludge is then removed from the process and dewatered. Final disposition of this waste is site-specific; however, opportunities for recycling are sometimes available.

The acid rain requirements in the Clean Air Act capped nationwide SO_2 emissions from power plants. Duke would need to obtain sufficient pollution credits from a set-aside pool or purchases on the open market to cover annual emissions from the coal-fired generation alternative. There is no market-based allowance system used for the emissions of NO_x.

The coal-fired generation alternative at the Lee Nuclear Station site would require a Prevention of Significant Deterioration (PSD) Permit and an operating permit under the Clean Air Act Amendments of 1990. The coal-fired generation alternative would need to comply with the new source performance standards (NSPSs) for such plants in 40 CFR 60, Subpart Da. The standards establish emission limits for PM and opacity (40 CFR 60.42Da), SO_2 (40 CFR 60.43Da), NO_x (40 CFR 60.44Da), and mercury (40 CFR 60.45Da).

The EPA has various regulatory requirements for visibility protection in 40 CFR 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as in attainment or unclassified under the Clean Air Act (40 CFR 51.307(a)). Criteria pollutants under the Clean Air Act are lead, ozone, particulates, CO, NO_2, and SO_2. Ambient air quality standards for criteria pollutants are in 40 CFR Part 50. The Lee Nuclear Station site in Cherokee County, South Carolina, is in an area designated as in attainment or unclassified for all criteria pollutants (40 CFR 81.347).

According to the EPA (EPA 2010a), the Charlotte-Gastonia-Rock Hill, North Carolina-South Carolina metro area is listed as having an 8-hour nonattainment status that is covered under Part D, Title I of the Clean Air Act regarding ozone. “Part D” is not a classification but is included as an indication of the requirements under the Clean Air Act that apply to areas of nonattainment. Additionally, Spartanburg, Anderson, and Greenville Counties have only recently been classified as being in attainment for ozone as of April 2008 under CFR Title 40 reporting guidelines.

Section 169A of the Clean Air Act establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when an impairment occurs due to air pollution from human activities. In addition, EPA regulations provide that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for days when visibility is most impaired over the period of the implementation plan and verify no degradation in visibility for the least visibility-impaired days over the same period (40 CFR 51.308(d)(1)). The closest mandatory Class I Federal area is Linville Gorge, which is approximately 65 mi northwest of the proposed site. If the coal-fired generation alternative were located close enough to a mandatory Class I area to affect visibility, additional air-pollution control requirements could be imposed. The preceding emissions estimate assumed the use of appropriate controls, which would limit the potential for impairment concerns.

South Carolina is one of 27 states whose stationary sources of criteria pollutants would have been subject to revised emission limits for SO_2 and NO_x under the Clean Air Interstate Rule (CAIR). South Carolina stationary sources of SO_2 and NO_x would be subject to this rule, as well as complementary regulatory controls developed at the State level (http://www.epa.gov/cair/index.html). On July 6, 2011, the EPA announced the finalization of the Cross-State Air Pollution Rule (CSAPR, previously referred to as the Transport Rule) as a response to previous court decisions and as a replacement to the CAIR. Following the August 2012 decision by the U.S. Court of Appeals for the D.C. Circuit to vacate the CSAPR, the CAIR remains in effect (EPA 2013a). Fossil fuel power plants in South Carolina would be subject to the CAIR and would be required to reduce emissions of SO_2 and NO_x to help reduce downwind ambient concentrations of fine particulates ($PM_{2.5}$) and ozone. However, the review team recognizes that the environmental impacts of air emissions from the coal-fired plant would be significantly greater than those from the Lee Nuclear Station site, even after application of the CAIR.

The EPA determined that coal-fired and oil-fired electric utility steam-generating units are significant emitters of the following hazardous air pollutants (HAPs): arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (65 FR 79825). The EPA concluded that mercury is the HAP of greatest concern and that (1) a link exists between coal combustion and mercury emissions, (2) electric utility steam-generating units are the largest domestic source of mercury emissions, and (3) certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects resulting from mercury exposures caused by the consumption of contaminated fish (65 FR 79825). On March 28, 2013, the EPA published a final rule with updates to emission standards, including mercury, for power plants under the Mercury and Air Toxics Standards (EPA 2013c). This rule became effective on April 24, 2013. However, the review team recognizes that the environmental impacts of air emissions from the coal-fired plant would be significantly greater than those from the Lee Nuclear Station, even after application of any new mercury emissions standards.

In the license renewal GEIS (NRC 2013a) the NRC staff indicates that air-quality impacts from a coal-fired power plant can be significant. The NRC staff also provides estimates of CO_2 and other emissions (NRC 2013a). Adverse human health effects, such as cancer and emphysema, have been associated with the byproducts of coal combustion. The fugitive dust emissions from construction activities would be mitigated using best management practices (BMPs), and would be temporary. Overall, the review team concludes that air-quality impacts from construction and operation of the coal-fired generation alternative at the Lee Nuclear Station site, despite the availability of BACT, would be MODERATE. The impacts would be clearly noticeable in the region but would not destabilize air quality.

Waste Management

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash, spent selective catalytic reduction (SCR) catalyst, and scrubber sludge. The coal-fired generation alternative would generate approximately 652,000 T/yr of ash. Significant quantities of the fly ash may be recycled for use in commodity products such as concrete, thereby limiting the total landfill volume. The coal-fired generation alternative would also generate more than 1,000,000 T/yr of flue gas scrubber sludge in the form of gypsum, which can also be recycled for use in wall board manufacturing (Duke 2009c).

The process of filtering suspended solids from incoming raw water (from the Broad River) can generate significant quantities of sludge, as well as general water-treatment sludge such as would be found in cooling-tower basins. Disposal of solid wastes could noticeably affect land use by requiring the devotion of substantial areas of land to provide landfill space. The total estimated volume of these two types of sludge exceeds 1800 T/yr, and would be disposed of in State-approved landfills either onsite or offsite.

In May 2000, the EPA issued a “Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels” (65 FR 32214). The EPA concluded that national regulation is warranted under Subtitle D of the Resource Conservation and Recovery Act of 1976, as amended (RCRA) when coal-combustion wastes are disposed of in landfills or surface impoundments, and that regulations under Subtitle D of RCRA (or modifications to existing regulations under the authority of the Surface Mining Control and Reclamation Act) are warranted when the wastes are used to fill surface impoundments or underground mines (65 FR 32214). In June 2010, the EPA proposed national standards regulating the disposal of coal-combustion wastes; they are currently evaluating two forms of regulation under Subtitle C and Subtitle D of RCRA (75 FR 35128).

Waste impacts on land use, groundwater, and surface water could extend beyond the operating life of the plant if leachate and runoff from the waste storage or coal pile area occurs. With appropriate controls and monitoring, waste impacts are not likely to destabilize any land or water resources. After closure of the waste site and revegetation, the land could be repurposed. Construction-related debris would be generated during plant development activities and disposed in approved landfills.

For the reasons stated above, the review team concludes that the impacts from waste generated at the coal-fired generation alternative would be MODERATE. The impacts would be noticeable, but not destabilizing of any resources.

Human Health

Coal-fired power generation introduces worker risks from coal and limestone mining, worker and public risk from coal and lime/limestone transportation, and worker and public risk from coal-combustion waste disposal. In addition, “releases from coal combustion contain naturally occurring radioactive materials – mainly uranium and thorium” (Gabbard 1993).

The EPA and State agencies base air emission standards and requirements on human health impacts. These agencies impose site-specific emission limits, as needed, to protect human health. Air emissions from a coal-fired power-generation plant located at the Lee Nuclear

Station site would be regulated by the South Carolina Department of Health and Environmental Control (SCDHEC). Given that the plant would have to comply with health-informed standards in the Clean Air Act and other relevant air emissions regulations, the review team concludes the human health impacts from the construction and operation of coal-fired generation at the Lee Nuclear Station site would be SMALL.

Other Impacts

Land Use

For the coal-fired alternative, approximately 2000 ac of land would need to be converted to industrial use for the power block, infrastructure and support facilities, ash and solids disposal, and coal and limestone storage and handling (Duke 2009c). This is more than twice the estimated 946-ac onsite land demand for the proposed nuclear station and would exceed the availability of land on the 1928-ac Lee Nuclear Station Site (see Section 4.1.1). Even if it were possible to fit the coal-fired generation facilities onto the Lee Nuclear Station site, the facilities would be crowded and there would be little opportunity to avoid environmentally sensitive land areas such as wetlands, floodplains, steep slopes, and prime farmland. The review team expects that Duke would either have to acquire substantial areas of additional land adjoining the site or find another site.

The land required for new transmission-line corridors would be similar to that reported in Section 4.1.3 for the transmission lines associated with the proposed nuclear facility. Land-use impacts would be noticeable to residents in the surrounding landscape, as described in Section 4.1.3. Land-use changes would also be expected to occur in the offsite coal-mining area supplying coal for the plant. The 1996 version of the GEIS (NRC 1996) estimated that approximately 22,000 ac of land would be needed for coal mining and waste disposal to support a 1000-MW(e) coal-fired plant during its operational life; this would scale up to approximately 48,000 ac for a 2200-MW(e) facility. This commitment of land for coal mining would likely have a noticeable effect on the availability of land in most regions of the United States.

Construction and operation of Make-Up Pond C would result in the permanent commitment of approximately 2110 ac of land, approximately 620 ac of which would be permanently impounded and flooded (see Section 4.1.2). Based on the inability to readily fit the proposed coal-fired generation facilities on the Lee Nuclear Station site as well as the overall amount of land affected due to the construction and operation of Make-Up Pond C, mining, and waste disposal, the review team concludes that land-use impacts would be MODERATE.

Water Use and Quality

The impacts on water use and quality from constructing and operating the coal-fired generation alternative at the Lee Nuclear Station site would be comparable to the impacts associated with a new nuclear power station. Cooling water would be withdrawn directly from the Make-Up Ponds (A, B, and C), which are supplemented by withdrawals from the Broad River. Plant discharges would consist mostly of cooling-tower blowdown, characterized primarily by an increased temperature and concentration of dissolved solids relative to the receiving waterbody, and intermittent low concentrations of biocides (e.g., chlorine). Treated process waste streams and sanitary wastewater may also be discharged. All discharges would be regulated by the SCDHEC through a National Pollution Discharge Elimination System (NPDES) permit. Indirectly, water quality could be affected by acids and mercury from air emissions: coal-fired power plants using wet flue gas desulphurization typically capture these compounds and dispose of them using approved regulatory paths. Water consumption would be similar to the proposed project, predominantly due to evaporative loss from the cooling towers. Overall, the review team concludes that the water-use and water-quality impacts would be SMALL.

Ecology

The coal-fired generation alternative would introduce impacts from construction and new incremental impacts from operations. As discussed in Section 4.3, impacts from building Make-Up Pond C may include wildlife habitat loss and fragmentation, reduced productivity, and a local reduction in biological diversity. Noticeable impacts could also occur at the proposed site and at the sites used for coal and limestone mining. As discussed in Section 5.3.1, cooling-tower drift would have only minimal impacts on terrestrial habitats on and near the site. The review team therefore concludes that the terrestrial ecological impacts would be MODERATE due to the potential impacts associated with Make-Up Pond C, and the large land area affected by mining.

As explained in Section 4.3.2, building Make-Up Pond C would substantially alter the aquatic ecology of London Creek. Extraction of cooling makeup water could affect aquatic resources in the Broad River and makeup ponds. Disposal of fly ash could affect water quality and the aquatic environment, but effective BMPs are readily available. Impacts from a coal-fired power plant on threatened and endangered species at the site would be similar to the impacts from a new nuclear power station. The review team concludes that the impacts on aquatic ecology would likely be MODERATE.

Socioeconomics

Adverse socioeconomic impacts would result from the approximately 1250 construction workers and approximately 2000 person peak workforce (Duke 2009c) used to build and operate the coal-fired generation alternative. Most construction workers would be temporary. Demands on housing and public services during construction would be SMALL. The review team concludes that impacts would be MODERATE (adverse) and localized to the vicinity of the Lee Nuclear Station site due to traffic- and transportation-related issues. During the period of plant construction and operation, the coal-fired generation alternative would likely pay a fee in lieu of taxes to Cherokee County that would be similar to the proposed project. Additional tax revenue would be expected from the influx of workers. The review team concludes that this would have a LARGE and beneficial impact on the county, and a SMALL and beneficial impact elsewhere in the region.

The four coal-fired units would have power-block structures up to 200 ft tall that would be visible offsite during daylight hours, particularly from the Broad River public access roads and McKowns Mountain Road. The four exhaust stacks could be as high as 650 ft. The stacks and associated emissions would likely be visible in daylight hours at distances greater than 10 mi. Cooling towers and associated plumes would also have aesthetic impacts. Mechanical draft cooling towers would be approximately 100 ft high. The power-block units and associated stacks and cooling towers would also be visible at night because of outside lighting. The Federal Aviation Administration (FAA) generally requires that all structures exceeding an overall height of 200 ft above ground level have markings and/or lighting so they do not impair aviation safety (FAA 2007). The visual effects of a new coal-fired power plant at the Lee Nuclear Station site could be further mitigated by landscaping and building color consistent with the environment. Visual impacts at night could be mitigated by reduced lighting, provided it meets FAA requirements, and appropriate shielding. Additionally, new transmission lines, as described in Section 3.2.2.3, would be expected to have noticeable aesthetic impacts associated with the steel towers, which are up to 190 ft. tall. The review team concludes the aesthetic impacts associated with the coal-fired generation alternative and associated new transmission lines at the Lee Nuclear Station site would be MODERATE.

The coal-fired generation alternative would introduce mechanical sources of noise that would be audible offsite. Sources contributing to the noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations and mechanical draft cooling towers. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime/limestone delivery, outside loudspeakers, and employees commuting to work. Noise impacts associated with rail delivery of coal and lime/limestone would be most significant for residents living near the facility and along the rail route. Given the necessary frequency of train transport to supply coal and limestone and the fact that many people are likely to be within hearing distance of the rail line, the review team concludes that the impacts of noise on residents in the vicinity of the facility and rail line would be MODERATE.

Environmental Justice

As discussed in Sections 4.5 and 5.5 of this EIS, no environmental pathways at the Lee Nuclear Station site result in disproportionate and adverse environmental impacts on identified minority or low-income populations in the 50-mi region. Therefore, the review team concludes that the environmental justice impacts on minority and low-income populations associated with the coal-fired generation alternative at the Lee Nuclear Station site would also be SMALL.

Historic and Cultural Resources

Impacts of locating the coal-fired generation alternative at the Lee Nuclear Station site would be similar to the impacts of locating a new nuclear power plant at the Lee Nuclear Station site. As discussed in Section 4.6, building and operating Make-Up Pond C would result in noticeable impacts on a historic cemetery. In addition, the Lee Nuclear Station site contains similar historic and cultural resources that may be affected by expanded ground-disturbing activities or visual intrusions. Cultural resource investigations would be needed for all areas of potential disturbance at the plant site; any offsite affected areas, such as mining and waste-disposal sites; and along new roads and transmission lines. These investigations would include field surveys; consultation with the appropriate State Historic Preservation Officer, American Indian Tribes, and the public; and possible mitigation of adverse effects from ground-disturbance or visual intrusions. Given the known historic and cultural resources in the area of the proposed Make-Up Pond C, the review team concludes that the historic and cultural resource impacts would be MODERATE.

Conclusion

Table 9-1 summarizes the impacts of building and operating the coal-fired generation alternative at the Lee Nuclear Station.

Table 9-1. Summary of Environmental Impacts of the Coal-Fired Generation Alternative

Impact Category	Impact	Comment
Air quality	MODERATE	SO_2 – 7814 T/yr NO_x – 1658 T/yr CO – 1658 T/yr PM_{total} – 64 T/yr PM_{10} – 17 T/yr CO_2 – 19,000,000 T/yr Small amounts of HAPs
Waste Management	MODERATE	Total waste volume would be approximately 652,000 T/yr of ash and an estimated additional 1 million T/yr of scrubber sludge.
Human health	SMALL	Regulatory controls and oversight would be protective of human health.

Table 9-1. (contd)

Impact Category	Impact	Comment
Land use	MODERATE	Uses approximately 2000 ac for power block and related facilities (greater than total land area of the site); coal handling, storage, and transportation facilities; infrastructure facilities; waste disposal; and cooling-water facilities. Additional land would be required for Make-Up Pond C and new transmission-line corridors. Mining activities would have additional impacts at undetermined offsite locations.
Water use and quality	SMALL	Discharges would be subject to protective regulatory controls. Water use would be minimal.
Ecology	MODERATE	Uses the undeveloped upland area of the Lee Nuclear Station site. Potential forest loss and fragmentation, reduced productivity and biological diversity could impact terrestrial ecology. Building of Make-Up Pond C would be expected to noticeably affect aquatic ecology due to inundation and flooding of London Creek. Additional impacts are associated with new transmission-line corridors and reconstruction of the railroad spur.
Socioeconomics	MODERATE (adverse) to LARGE (beneficial)	Construction-related impacts would be minor and adverse with the following exceptions: traffic-related impacts would be noticeable and adverse; and construction-related economic impacts would be minor and beneficial everywhere in the region, except for Cherokee County, where they would be substantial and beneficial. Impacts during operation would likely be smaller than during construction. The local tax base would benefit mainly during operations, where the impacts would be minor and beneficial in the region and noticeable and beneficial in Cherokee County. The power plant and new transmission lines would have noticeable adverse aesthetic impacts. Some offsite noise impacts would occur during operations, resulting in a noticeable adverse impact.
Historic and cultural resources	MODERATE	Impacts would be similar to those associated with a new nuclear power station located at the Lee Nuclear Station site, including noticeable impacts on a historic cemetery from construction of Make-Up Pond C. Known cultural resources within the Lee Nuclear Station site and undiscovered resources in associated offsite developments could be impacted.
Environmental justice	SMALL	No environmental pathways exist by which the identified minority or low-income populations in the 50-mi region would be likely to suffer disproportionate and adverse environmental impacts.

9.2.2.2 Natural Gas-Fired Power Generation

For the natural-gas-fired alternative, the review team assumed the building and operation of four natural-gas combined-cycle (NGCC) units, each with a net capacity of 600 MW(e) at the Lee Nuclear Station site for a gross capacity of 2400 MW(e). The review team's selection of the combined-cycle units is consistent with Duke's recent experience in permitting and constructing the Buck and Dan River units, and is reasonable. The review team assumed the acquisition and use of the same transmission-line rights-of-way discussed in Section 3.2.2.3. The new natural-gas-fired generation units are assumed to have an operating life of 40 years (the same operating life as allowed initially for a nuclear plant under a COL, even though that number has no regulatory applicability to non-nuclear power plants).

The review team also considered and evaluated the construction and operation of Make-Up Pond C, recognizing that the demand for water consumption from a combined-cycle power plant would be less than either the proposed project or the coal-fired alternative. However, assuming the use of a closed-cycle cooling system and mechanical draft cooling towers located at the Lee Nuclear Station site, the review team concluded (through confirmatory analysis) that Make-Up Pond C would still be required, though possibly smaller in total surface area and volume. Further discussion regarding cooling water and Make-Up Pond C alternatives can be found in Section 9.4.1.

Air Quality

Natural gas is a relatively clean-burning fuel. When compared with a coal-fired plant, natural-gas-fired plants release similar types of emissions such as NO_x and PM, but in significantly lower quantities. A new natural-gas-fired power-generation plant would require a PSD Permit and a State-specific operating permit under the Clean Air Act, and would be subject to the NSPSs specified in 40 CFR Part 60, Subparts Da and GG, which establish emission limits for particulates, opacity, SO_2, and NO_x. Final permitting to operate the plant would require applicable BACT as part of the new source review requirements under Title 1 of the Clean Air Act.

The EPA has various regulatory requirements for visibility protection in 40 CFR 51, Subpart P, including a specific requirement for review of any new major stationary source in areas designated as in attainment or unclassified under the Clean Air Act. As previously discussed, the Lee Nuclear Station site in Cherokee County, South Carolina, is in an area designated as in attainment or unclassified for all criteria pollutants (40 CFR 81.347).

Section 169A of the Clean Air Act establishes a national goal of preventing future impairment of visibility and remedying existing impairment in mandatory Class I Federal areas when impairment is from air pollution caused by human activities. In addition, EPA regulations provide that for each mandatory Class I Federal area located within a State, State regulatory agencies must establish goals that provide for reasonable progress toward achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period (40 CFR 51.308(d)(1)). As previously discussed, the closest Class I Federal area is located approximately 65 mi northwest of the Lee Nuclear Station site. If the natural-gas-fired alternative were located close enough to a mandatory Class I area to affect visibility, additional air-pollution control requirements could be imposed. The preceding emissions estimate assumed the use of appropriate controls that would limit the potential for impairment concerns.

Emission estimates are based on “as-fired” and controlled conditions. The review team calculated the following emissions estimates using EPA (2000) AP-42 Emission Factors guidelines for stationary internal combustion sources. The review team also assumed that the NGCC units would be equipped with conventional and commonly used emission control technology:[(a)]

- SO_2 – 31 T/yr
- NO_x– 546 T/yr
- CO – 207 T/yr
- PM_{total} – 105 T/yr
- PM_{10} – 105 T/yr.

In addition, the review team estimates that the natural-gas-fired alternative would have CO_2 emissions of 6,071,000 T/yr.

The fugitive dust emissions from construction activities would be mitigated using BMPs and would be temporary. Other construction and operation impacts, such as the development and use of material laydown areas and parking, would be minor.

The impacts of emissions from the natural-gas-fired alternative would be noticeable, but would not be sufficient to destabilize air resources. Overall, the review team concludes that air-quality impacts resulting from construction and operation of the natural-gas-fired alternative at Lee Nuclear Station site would be SMALL to MODERATE.

Waste Management

In the 1996 version of the GEIS, the NRC staff concluded that waste generation from natural-gas-fired technology would be minimal (NRC 1996). Wastes generated at conventional NGCC plants include catalysts and materials from the control of NO_X and CO emissions. These materials contribute to waste-disposal needs, and thus require removal over time. Waste generation at an operating NGCC plant would be largely limited to typical operations and maintenance waste. Construction-related debris would be generated during construction activities. Overall, the review team concludes that waste impacts from the operation of the natural-gas-fired alternative would be SMALL.

(a) The review team assumed a standard “2X1” configuration for a single unit total of 600 MW(e), and annual natural-gas consumption of 110,376,000 million BTU/yr, SCR at 90 percent conversion, and CO catalyst at 75 percent conversion.

Human Health

The risks from NGCC air emissions may be attributable to compounds that contribute to ozone formation, which in turn contribute to health risks. Air emissions from the natural-gas-fired alternative at the Lee Nuclear Station site would be regulated by the SCDHEC. The human health effect is expected to be either undetectable or minor. Overall, the review team concludes the impacts on human health would be SMALL.

Other Impacts

Land Use

Large NGCC plants can be sited on relatively small parcels of land, and are estimated to require only about 200 ac for the power block and support facilities (Duke 2008g). These facilities could be readily situated within the 1928-ac Lee Nuclear Station site with no more than minimal encroachment into environmentally sensitive land areas such as wetlands, floodplains, steep slopes, and prime farmland. As proposed, the natural-gas-fired alternative would be expected to use land mostly within the 750 ac already disturbed at the Lee Nuclear Station site for the construction of the power blocks. There are four natural-gas pipelines located approximately 4 mi northwest of the Lee Nuclear Station site. Assuming a right-of-way width of 100 ft, the review team estimates a 4-mi natural-gas pipeline would encompass approximately 48 ac of land. The addition of baseload-capable NGCC units at the Lee Nuclear Station site would require an expansion of natural-gas trunkline capacity, which would include the addition of approximately 50 to 60 mi of new pipeline. Duke has indicated this could be accomplished within the existing right-of-way, minimizing disturbances to the affected areas (Duke 2011e). Additionally, the 1996 version of the GEIS (NRC 1996) estimated that approximately 3600 ac. of land would be required for wells, collection stations, and pipelines to bring the natural gas to a 1000-MW(e) NGCC facility. For an NGCC facility of 2400 MW(e), the review team estimates the additional land required for gas production and delivery would be 8640 ac. However, due to the proximity of the Lee Nuclear Station site to existing natural-gas infrastructure, and the ability to use the existing right-of-way, the impacts from developing the natural-gas infrastructure should be minimized.

Although the NGCC units would require less cooling water than the proposed nuclear units, the building and operation of Make-Up Pond C would still be required to provide supplemental cooling water to the NGCC units during periods of drought. The review team considered Duke’s analysis and conducted a confirmatory assessment, concluding that Make-Up Pond C would still be required, though likely using a smaller geographic footprint. Duke estimated that Make-Up Pond C built to support the natural-gas-fired alternative would be approximately 363 ac (as compared to a 643-ac pond that would be required for coal or nuclear). Although the pond would be smaller, it would still result in the flooding and permanent commitment of substantial land areas in the London Creek drainage (Duke 2011e). The review team expects that a substantial additional portion of the Make-Up Pond C site would be required to accommodate ancillary facilities and activities associated with the pond, such as spoils disposal, vegetation maintenance, a pumphouse, and access roads and other utilities (described in Section 4.1.2). Even though the combined land demands for the smaller Make-Up Pond C would likely be substantially lower than the roughly 1047 ac estimated for the nuclear Make-Up Pond C, the review team expects that Duke would still have to acquire and permanently dedicate the entire 2110-ac Make-Up Pond C site to the pond. Duke would still have to acquire and remove the 86 privately owned housing units, as described in Section 4.1.2. The overall effects would be similar to those described for the Lee Nuclear Station in Section 4.1.2.

The land required for new transmission-line corridors would be similar to that reported in Section 4.1.3 for the transmission lines associated with the proposed nuclear facility. Based on the overall amount of land affected, particularly the land needed for Make-Up Pond C and the new transmission-line corridors, the review team concludes that land-use impacts from the natural-gas-fired alternative at the Lee Nuclear Station site would be MODERATE.

Water Use and Quality

The NGCC plants would consume less water for cooling than the coal or nuclear alternatives. The impacts on water use and quality from building and operating the natural-gas-fired alternative at the Lee Nuclear Station site would be similar to or less than the impacts associated with constructing and operating a new nuclear facility. Closed-cycle cooling with cooling towers is assumed. Ground disturbance might result in some impacts on surface-water quality in the form of increased sediment loading in stormwater runoff from erosion in the active construction zones; however, the required permits, certifications and stormwater pollution prevention plan (SWPPP) would call for the implementation of BMPs to minimize impacts, as discussed for the nuclear plant in Section 4.2. The impacts on water quality from erosion and sedimentation during construction of a natural-gas-fired power plant were characterized in the 1996 version of the GEIS 7 as SMALL (NRC 1996). The NRC also noted in the GEIS that the impacts on water quality from operations would be similar to, or less than, the impacts from other generating technologies. Overall, the review team concludes that impacts on water use and quality would be adequately controlled by permits and, therefore, would be SMALL.

Ecology

As discussed in Section 4.3, impacts from building Make-Up Pond C may include wildlife habitat loss and fragmentation, reduced productivity, and a local reduction in biological diversity. While the pond would be smaller, the habitat losses and disturbances resulting from building the pond would still be noticeable. As discussed in Section 5.3.1, cooling-tower drift would have only minimal impacts on terrestrial habitats on and near the site. The review team therefore concludes that the terrestrial ecological impacts would be MODERATE.

Similar to the impacts described in Section 4.3.2, building Make-Up Pond C, even one of only 363 ac, would substantially alter the aquatic ecology of London Creek. Extraction of cooling makeup water could affect aquatic resources. Impacts from the natural-gas-fired alternative on Federally listed threatened or endangered species would be similar to the impacts from a new nuclear power station. The review team concludes that the impacts on aquatic ecology would likely be MODERATE.

Socioeconomics

Impacts would result from the approximately 800 workers needed to construct the natural-gas-fired alternative, the demands on housing and public services during construction, and the loss of jobs after construction. The natural-gas-fired alternative would require approximately 150 permanent operators and staff once operational (Duke 2008q). Overall, the review team concludes that these impacts would be SMALL because of the mitigating influence of the site's proximity to the surrounding population area and the relatively small number of workers needed to construct and operate the plant in comparison to nuclear and coal-fired generation alternatives. The natural-gas-fired alternative would likely pay a fee in lieu of taxes to Cherokee County. Additional tax revenue would be expected from the influx of workers. Though this would likely be less than the value assigned to the proposed project, the review team concludes that the fee and tax revenue would have at least a MODERATE beneficial impact on the county.

The natural-gas-fired alternative would have several features visible during daylight hours from offsite including the heat-recovery steam generators, exhaust stacks, cooling towers, and water vapor plumes. Noise and light from the NGCC units would be detectable offsite during construction and operation. Additionally, new transmission lines, as described in Section 3.2.2.3, would be expected to have noticeable aesthetic impacts associated with the steel towers, which are up to 190 ft tall. Overall, the review team concludes that the aesthetic impacts associated with the natural-gas-fired alternative at the Lee Nuclear Station site and the new transmission-line right-of-way would be MODERATE.

Environmental Justice

As discussed in Sections 4.5 and 5.5 of this EIS, no environmental pathways at the Lee Nuclear Station site result in disproportionate and adverse environmental impacts on identified minority or low-income populations in the 50-mi region. Therefore the review team concludes that the environmental justice impacts on minority and low-income populations associated with the natural-gas-fired alternative at the Lee Nuclear Station site would be SMALL.

Historic and Cultural Resources

Impacts of the natural-gas-fired alternative located at the Lee Nuclear Station site would be generally similar to the impacts for a new nuclear power station. As discussed in Section 4.6, building Make-Up Pond C would result in noticeable impacts on a historic cemetery. Those impacts would still occur with a pond of 363 ac. Cultural resource investigations would likely be needed for any onsite property that has not been previously surveyed, including Make-Up Pond C, and in any offsite affected areas, such as those containing new transmission lines and gas pipelines. These investigations would include field surveys; consultation with the appropriate State Historic Preservation Officer, American Indian Tribes, and the public; and possible mitigation of the adverse effects from ground disturbance or visual intrusions. Given the known historic and cultural resources in the area of the proposed Make-Up Pond C, the review team concludes that the historic and cultural resource impacts would be MODERATE.

Conclusion

Table 9-2 summarizes the impacts of building and operating the coal-fired generation alternative at the Lee Nuclear Station.

Table 9-2. Summary of Environmental Impacts of the Natural-Gas-Fired Alternative

Impact Category	Impact	Comment
Air quality	SMALL to MODERATE	SO_2 – 31 T/yr NO_x – 546 T/yr CO – 207 T/yr PM_{10} – 105 T/yr CO_2 – 6,071,000 T/yr
Land use	MODERATE	Approximately 200 ac would be needed onsite for the power block, cooling towers, and support systems. Additional land would be needed for a 4-mi gas pipeline, Make-Up Pond C, transmission-line corridor, infrastructure, and other facilities.
Water use and quality	SMALL	Impacts would be similar to or less than the impacts for a new nuclear power plant located at the site.
Ecology	MODERATE	Would primarily use previously disturbed areas of the Lee Nuclear Station site. The building of Make-Up Pond C, inundating about 363 ac, would be expected to noticeably affect aquatic ecology due to inundation and flooding of London Creek. Additional impacts are associated with new transmission lines and reconstruction of the railroad spur.
Socioeconomics	MODERATE (adverse) to MODERATE (beneficial)	Construction and operations workforces would be relatively small in comparison to a nuclear or coal-fired power plant. The additional revenue to the local tax base, while smaller than for a nuclear or coal-fired plant, would be noticeable and beneficial. Impacts during operation would be minor because of the small workforce involved. The plant and new transmission lines would have noticeable aesthetic impacts.

Table 9-2. (contd)

Impact Category	Impact	Comment
Historic and cultural resources	MODERATE	Impacts would be similar to those associated with a new nuclear power station located at the Lee Nuclear Station site, including noticeable impacts due to the construction of Make-Up Pond C. Avoidance or mitigation of known cultural resources would be expected in accordance with State and Federal law.
Waste management	SMALL	Waste generation, including that from spent catalyst used for emissions control, would be minimal.
Human health	SMALL	Regulatory controls and oversight would be protective of human health.
Environmental justice	SMALL	There are no environmental pathways by which the identified minority or low-income populations in the 50-mi region would be likely to suffer disproportionate and adverse environmental impacts

9.2.3 Other Alternatives

This section discusses other energy alternatives, the review team's conclusions about the feasibility of each alternative, and the review team's basis for its conclusions. New nuclear units at the proposed site would provide baseload generation. Any feasible alternative to the new units would need to be capable of generating baseload power with high availability and capacity factors. As part of the annual IRP processes, and in accordance with NUREG-1437, *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NRC 1996), Duke explored a wide range of competitive power generating alternatives including conventional, demonstrated, and emerging technologies (Duke 2012a). The review team reviewed the information Duke submitted, conducted an independent review, and consulted additional resources as needed. The review team finds that the following generation options are not reasonable alternatives to the baseload generation the proposed Lee Nuclear Station Units 1 and 2 would provide.

The review team has not assigned significance levels to the environmental impacts associated with the alternatives discussed in this section because, in general, the generation alternatives would likely require installation at a location other than the proposed Lee Nuclear Station site. Any attempt to assign significance levels would require speculation about the unknown site(s).

9.2.3.1 Oil-Fired Power Generation

The EIA's reference case projects that oil-fired power plants would not account for any new electric power generation capacity in the United States through the year 2035 (DOE/EIA 2011), although oil-firing in combustion turbines is often used to supplement natural-gas feed stock.

Oil-fired generation is more expensive than nuclear, natural-gas-fired, or coal-fired generation options. In addition, future increases or broad speculation in oil prices and oil markets are expected to make oil-fired generation increasingly more expensive. The high cost of oil has resulted in a decline in its use for electricity generation. In the 1996 version of the GEIS (NRC 1996), the NRC staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 120 ac of land with additional acreage expected to be committed to onsite fuel storage. Operation of an oil-fired power plant would have environmental impacts similar to those of a comparably sized coal-fired plant (NRC 1996).

For the preceding economic and environmental reasons, the review team concludes that an oil-fired power plant at or in the vicinity of the proposed Lee Nuclear Station site would not be a reasonable alternative to construction and operation of a 2200-MW(e) nuclear power plant supplying baseload electricity.

9.2.3.2 Wind Power

The Lee Nuclear Station site is in a wind power Class 1 region with average wind speed lower than 5.6 m/s (DOE 2009b). Class 1 regions have the lowest potential for generation of wind energy and are considered unsuitable for the development of wind energy (Dahle et al. 2008). The coastal regions of North Carolina and South Carolina are recognized as being capable of supporting offshore utility-scale as well as isolated onshore wind generation (NREL 2009a). Though outside of the respective service territory, the continuing development of wind-generation resources as part of Duke's resource portfolio may be conducted through purchased power options, the purchase of renewable energy credits (RECs), or joint ventures. Duke is actively pursuing the development of wind-generation resources as part of its renewable energy resource portfolio. As an example, and in accordance with North Carolina's general requirements to generate or procure resources equal to 3 percent of its 2011 retail sales, Duke has entered into agreements to procure out-of-state RECs for wind to the extent possible (NCUC 2012a). It is noted that these are not capacity purchases, but energy purchases. Reflective of the growing use of wind resources, the NCUC has recently approved a Certificate of Public Convenience and Necessity (CPCN) to Atlantic Wind, LLC for the construction and operation of a 300-MW(e) wind facility consisting of up to 150 wind turbines in Pasquotank and Perquimans Counties, North Carolina (NCUC 2011b).

Newer wind turbines typically operate at approximately a 36 percent capacity factor (DOE 2009b), compared with 90 percent for a baseload plant such as a nuclear power station (NEI 2013). The largest operating wind farm has a more than 1000-MW generating capacity (Terra-Gen 2013); however, the installed capacities of most wind farms are under 200 MW. Although some modern wind turbine designs are approaching 5 MW(e), it is likely that well over 800 average sized 2.5-MW(e) wind turbines would be required to match the capacity of the 2200 MW(e) of the proposed nuclear units. Assuming an average net capacity factor in North Carolina of 32 percent (LaCapra Associates 2006), more than 2700 such wind turbines would be needed to generate a commensurate amount of energy to equal that expected from the proposed nuclear plants. An onshore or land-based utility-scale wind-generation plant would require on average about 84 ac/MW(e) of installed capacity, although much of this land could be used for other purposes (NREL 2009b). Using this assumption, as well as the assumption of an average net capacity factor of 32 percent, construction of land-based wind-generation facilities equivalent to the 2200 MW(e) that could be provided by the proposed Lee Nuclear Station units could require more than 500,000 ac of land. As an example, the Atlantic Wind, LLC application for the CPCN indicated that approximately 20,000 ac would be involved for the 300-MW(e) project (NCUC 2011b). If forested, tree cover would have to be cleared from all or much of the land resulting in substantial aesthetic impacts, cultural resource impacts, and losses of habitat for forest-dwelling terrestrial wildlife. Portions of the land not immediately situated at a wind turbine structure could provide habitat for terrestrial wildlife favoring old-field or grassland habitat, although the value of the habitat might be somewhat compromised by its proximity to the turbine blades. The moving turbine blades could pose a risk of physical injury to wildlife attracted to the habitat. Because of the inherent variability of wind as a resource, the capacity from wind turbines may supply firm deliverable power when coupled with a power source that is capable of being dispatched when the capacity is required such as energy-storage mechanisms (e.g., compressed air energy-storage, batteries) or additional resources such as pumped-storage hydropower (NPCC 2010). This requires both the wind resource and the storage mechanism to be within reasonable proximity of each other, and of commensurate power output when used singly or in combination. The EIA is not projecting any growth in pumped-storage capacity through 2035 (DOE/EIA 2011). In addition, the review team concludes in Section 9.2.3.4 that the potential for new hydroelectric development in North Carolina and South Carolina is limited. Therefore, the review team concludes that the use of pumped storage in combination with wind turbines to generate 2200 MW(e) is unlikely in North Carolina or South Carolina.

A conventional compressed air energy-storage (CAES) plant consists of motor-driven air compressors that use low-cost, off-peak electricity to compress air into an underground storage medium. During periods of high electricity demand, the stored energy is recovered by releasing the compressed air through a combustion turbine to generate electricity (NPCC 2010). There are other proposed configurations of CAES, however only two CAES plants are currently in operation. A 290-MW plant near Bremen, Germany, began operating in 1978. A 110-MW(e) plant located in McIntosh, Alabama, has been operating since 1991. Both facilities use mined salt caverns (Succar and Williams 2008). A CAES plant requires suitable geology such as an underground cavern for energy storage. A 268-MW(e) CAES plant coupled to a wind farm, the Iowa Stored Energy Park, was proposed for construction near Des Moines, Iowa. The facility would have used a porous rock storage reservoir for the compressed air (Succar and Williams 2008). However, this project has been terminated (ISEPA 2011). Other pilot, demonstration, prototype, and research projects involving CAES have been announced, including projects in California, New York, and Texas. To date, nothing approaching the scale of a 2200-MW(e) facility has been contemplated. Therefore, the review team concludes that the use of CAES in combination with wind turbines to generate 2200 MW(e) is unlikely in North or South Carolina.

The U.S. Department of Interior Minerals Management Service (MMS, now the Bureau of Ocean Energy Management, Regulation and Enforcement) has jurisdiction, as authorized in the Energy Policy Act of 2005, over alternative energy-related projects on the outer continental shelf (OCS), including wind power developments. In its final “Programmatic EIS for Alternative Energy Development and Production and Alternate Uses of facilities on the Outer Continental Shelf” (DOI 2007), the MMS considered the potential environmental, social, and economic impacts from wind energy (among other) projects on the OCS. The MMS indicated that the technologies used to extract energy on the OCS are “… relatively new and untested in the offshore environment of the OCS.” In developing the programmatic EIS, the MMS focused on “… those technologies that are likely to be initiated–for research, demonstration, or commercial scale—within the 5- to 7-year time frame.” In the time since the Programmatic EIS was finalized, no projects have been initiated on the OCS. MMS issued final regulations in April 2009 (74 FR 19638) to establish a program to grant leases, easements, and rights-of-way for renewable energy project activities on the OCS.

There are considerable challenges to both onshore and offshore wind turbines. The National Renewable Energy Laboratory (NREL) issued an analysis of offshore wind power in *Large-Scale Offshore Wind Power in the United States—Assessment of Opportunities and Barriers* (Musial and Ram 2010). As Musial and Ram indicate, “… the opportunities for offshore wind are abundant, yet the barriers and challenges are also significant. … Technological needs are generally focused on making offshore wind technology economically feasible and reliable and expanding the resource area to accommodate more regional diversity for future U.S. offshore projects.” When energy policies mature and large-scale offshore wind-energy projects become technically feasible, they could play a significant role in U.S. energy markets. The NREL report considers the wind-energy potential and the proposed U.S. offshore wind projects and capacities; it divides wind-energy projects into two groups: those within State boundaries (within 3 nautical mi) and those in Federal waters. Regionally, there were two projects under consideration, neither of which appear to be moving forward at this time. One project was led by University of North Carolina (in conjunction with Duke) to study, install, and operate up to three wind turbines in Pamlico Sound, North Carolina. The other was a Federal lease project in Georgia estimated to be up to 10 MW(e) (Musial and Ram 2010). No other regional wind-energy projects were identified by NREL in either State or Federal waters.

For the preceding reasons, the review team concludes that wind power is not a reasonable alternative to construction and operation of a 2200-MW(e) nuclear power plant supplying baseload electricity.

9.2.3.3 Solar Power

Solar technologies use energy and light from the sun to provide heating and cooling, light, hot water, and electricity for consumers. Solar energy is converted to electricity using solar thermal technologies or photovoltaics (PVs). In grid-connected, utility-scale applications, solar power does not currently compete well with conventional nuclear and fossil-fueled technologies due to solar power's lower capacity factors and higher capital cost per kilowatt of capacity. Capacity factors of solar technologies are directly related to both solar resource and the conversion efficiency of the technology. An average capacity factor of PV cells in the United States is about 18 or 19 percent (DOE 2011c). The capacity factor in the Carolinas would fall somewhere between that of Boston (as high as 24 percent) and Miami (as high as 26 percent) if panels with two-axis tracking are used (DOE 2011c). The capacity factor for solar thermal systems[(a)] is about 20 to 28 percent without storage, and up to 40 to 50 percent with storage (DOE 2011c). Though solar technologies are not capable of generating traditional baseload power, the power produced may be stored and used when the sun is not shining when coupled to energy-storage mechanisms such as batteries. Large, utility-scale solar technologies also require a significant dedicated land area; NREL estimated from approximately 5 to 12 ac/MW of installed capacity for solar thermal and PV concentrators (NREL 2004). A solar-based power plant equivalent to the proposed project would require an estimated 11,000 to 26,400 ac of land.

Solar thermal technologies use concentrating devices to create temperatures suitable for bulk power production. There are several types of solar thermal power systems. The deployment of which technology depends on the solar resource, but utility-scale configurations are capable of generating enough heat to produce steam, which is used in a conventional steam turbine. The largest operational solar thermal plant is the 354-MW Solar Energy Generating Station located in southern California (Simons 2005).

For flat-plate, or PV type solar collectors, Duke has acceptable and available resources throughout the service territory, and while utility-scale installations require very large tracts of dedicated land, the advantage of PV solar technology lies in its deployment flexibility when used as part of a comprehensive distributed generation portfolio as evidenced by the significant contribution of solar PVs from customer-owned self-generation resources (Duke 2012a). As part of Duke's compliance with the North Carolina renewable energy portfolio standards (REPS) plan, Duke is engaged in several activities providing both solar capacity and RECs. Examples include Duke's 20-year purchase power agreement with Sun Edison for up to 15.5 MW(e), and long-term purchase agreements for both in-state and out-of-state RECs from solar applications (Duke 2012a).

(a) The use of concentrating solar power in the Carolinas is unlikely. The DOE considers select areas in seven states (Arizona, California, Colorado, Nevada, New Mexico, Texas, and Utah) as suitable for the development of concentrating solar power (DOE 2011c).

For the preceding reasons, the review team concludes that solar energy is not a reasonable alternative to construction and operation of a 2200-MW(e) nuclear power plant supplying baseload electricity.

9.2.3.4 Hydropower

Duke has over 1000 MW(e) of existing hydroelectric generating capacity. Approximately 1000 MW(e) of developable hydroelectric resources exist across North Carolina and South Carolina, with only one site capable of producing more than 76 MW(e) (INEEL1998). A much smaller subset would be accessible by Duke within its given service territory. Duke is actively engaged in multiple relicensing activities related to hydropower, but these projects will not increase current capacity. As stated in Section 2.3.3.1 of the GEIS (NRC 2013a), hydroelectric facilities have become difficult to site because of public concerns about flooding, destruction of natural habitat, and alteration of natural river courses. The EIA references projected stable electricity production from existing resources through 2035 (DOE/EIA 2011). In the 1996 version of the GEIS (NRC 1996), the NRC staff estimated that land requirements for hydroelectric power are approximately 1 million ac/1000 MW(e).

Due to the relatively low number of undeveloped hydropower resources available, and the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to produce 2200 MW(e), the review team concludes that hydropower is not a reasonable alternative to construction and operation of a 2200-MW(e) nuclear power plant supplying baseload electricity.

9.2.3.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. Geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii, where hydrothermal reservoirs are prevalent (DOE 2006). Neither South Carolina nor North Carolina has high-temperature geothermal resources that would be suitable for power generation (DOE 2008a, b).

Therefore, the review team concludes that a geothermal energy facility would not be a reasonable alternative to construction and operation of a 2200-MW(e) nuclear power plant supplying baseload electricity.

9.2.3.6 Wood Waste

A wood-burning facility can provide baseload power and operate with a high annual capacity factor (EPA 2007d; NREL 2013)and with thermal efficiency similar to a coal plant. Further, the State of North Carolina indicated that wood waste qualifies as a “Renewable Energy Resource” under Senate Bill 3 defining the new REPS. Duke, in the 2010 REPS compliance plan provided to the NCUC, indicates that it is actively pursuing biomass resources as part of its general requirement obligation including investigations into direct firing, co-firing, landfill gas, and combustion of waste gases (NCUC 2010b).

The fuels required are variable and site-specific. North Carolina and South Carolina have substantial wood-based biomass resources capable of producing tens of millions of pounds of usable biomass each year between commercial thinning operations and/or residue management. However, there are significant impediments to the use of wood waste to generate electricity, including the total cost of delivered fuel (harvesting and transportation), and the quantity of acceptable fuel required. The larger wood-waste power plants are 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impacts per megawatt of installed capacity would be approximately the same as that for a coal-fired plant, although facilities using wood waste for fuel would be built at significantly smaller scale (NRC 2013a). Similar to coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve similar types of combustion and combustion control equipment.

Considering that wood waste plants typically combust approximately 1 ton/hr to generate 1 MW(e) (ORNL 2004), it would take approximately 4.4 million lb/hr, or 35 billion lb/yr of wood waste to generate an equivalent amount of energy as the proposed project. Further, it is recognized that close proximity to the fuel source is a critical indicator of project feasibility; with such a high demand for wood waste, it would not be reasonable to conclude that such access could be afforded to a facility with such a high demand for fuel.

Because of uncertainties associated with obtaining sufficient wood and wood waste to fuel a baseload power plant, and the relatively small total generating capacity per unit, the review team determined that combustion of wood waste would not be a reasonable alternative to construction and operation of a 2200-MW(e) nuclear power plant supplying baseload electricity.

9.2.3.7 Municipal Solid Waste

Municipal solid-waste facilities incinerate waste and use the resultant heat to produce steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight by up to 75 percent (EPA 2009). Municipal waste combustion facilities use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001). Mass burning technologies are most commonly used in the United States. This group of technologies processes raw municipal solid waste “as is,” with little or no sizing, shredding, or separation before combustion.

Municipal solid-waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue gases using fabric filters and/or scrubbers (DOE/EIA 2001).

Approximately 86 waste-to-energy plants are operating in the United States. These plants generate 2600 MW(e) or an average of approximately 30 MW(e) per plant (Michaels 2010). Given the small size of the plants, the review team concludes that generating electricity from municipal solid waste would not be a reasonable alternative to a 2200-MW(e) nuclear power plant supplying baseload electricity.

One additional generating resource that uses municipal solid-waste as a fuel derivative is the capture and combustion of landfill-based gas (LFG). In compliance with the REPS provisions, Duke Energy has executed several power purchase agreements for firm capacity from LFG generators (Duke 2012a). This is in addition to previously established power purchase agreements for up to 10 MW(e) of landfill gas based generation capacity from PURPA-qualifying facilities (Duke 2012a). Given the relatively small size of the plants and the finite number of usable resources, the review team concludes that generating electricity from LFG would not be a reasonable alternative to construction and operation of a 2200-MW(e) nuclear power plant supplying baseload electricity.

9.2.3.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid-waste fuel, several other biomass-derived fuels are available for fueling electric generators, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste).

The EIA estimates that biomass will be a significant source of renewable electricity generation among the non-hydropower renewable fuels through 2035 (second to wind), and that growth in biomass-based generation capacity is expected in regions with stringent REPS requirements and limited supplies of lower cost resources such as wind (DOE/EIA 2011). Significant biomass resources are available in both North Carolina and South Carolina in the form of woody residues and crop-based biomass, and are expected to contribute to the overall production of energy and fuels in the future. Further, both states have created biomass councils through their respective state energy offices. South Carolina has created a biomass council through its South Carolina Energy Office to capitalize on increasing energy diversity and enhancing environmental quality for South Carolina (South Carolina Energy Office 2007). Additionally, the NCUC, under the REPS program, has defined biomass as a “renewable energy resource,” which also includes solar, wind, and additional non-fossil-based fuel sources, and expects that biomass will be part of future capacity within the state (Duke 2012a). In its 2012 IRP (Duke 2012a), Duke has reduced its expectations for growth in biomass sources while increasing its expectations for growth in solar and wind resources. This shift was driven primarily by decreasing costs and increasing proposals for solar facilities in the region.

Co-firing biomass with coal is possible when low-cost biomass resources are available. Co-firing biomass has been successfully demonstrated in most iterations of boiler technologies, can reduce emissions from coal-only-fired power plants, and is the most economically viable option for near-term introduction of new biomass power generation (DOE 2011a). However, the practice of co-firing does not increase capacity.

In addition to wood and municipal solid-waste fuel, several other biomass-derived fuels are available for fueling electric generators. These include, but are not limited to, animal-derived wastes, crop-based biomass, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). In compliance with the North Carolina REPS provisions, Duke has pursued energy or energy credits through set-aside agreements or as part of its general requirements (Duke 2012a).

Construction of a biomass-fired plant would have an environmental impact similar to a coal-fired plant, although facilities using wood waste and agricultural residues for fuel would be built on smaller scales. Like coal-fired plants, biomass-fired plants require areas for fuel storage, processing, and waste (e.g., ash) disposal. In addition, operation of biomass-fired plants has environmental impacts, including potential aquatic ecology and air-quality impacts.

Given the limited capacity of the plants, the review team concludes that biomass-derived, or biomass co-fired fuels used singly or in combination with other fossil fuels is not a reasonable alternative to construction and operation of a 2200-MW(e) nuclear power plant supplying baseload electricity.

9.2.3.9 Fuel Cells

Fuel cells work without combustion and its associated environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode, air over a cathode, and then separating the two by an electrolyte. The only byproducts are heat, water, and CO_2. Hydrogen is typically derived from hydrocarbon-based fuels by subjecting them to steam reforming or partial oxidation, or through the electrolysis of water. Natural gas is commonly used as a primary source of hydrogen.

Phosphoric acid fuel cells are generally considered first-generation technology. During the past three decades, significant efforts have been made to develop more practical and affordable fuel cell designs for stationary power applications and the first-generation technologies have given way to membrane- and solid-oxide-based fuel cells operating consistently above 50 percent electrical efficiency (DOE 2010b). High-temperature, second-generation fuel cells have achieved increased fuel-to-electricity and thermal efficiencies. This enables second-generation fuel cell systems to produce both electricity and generate steam such as in distributed generation type combined heat and power applications.

Research in both stationary and transportation-based fuel cells is intended to provide continuing improvements of both materials and components as they relate to system cost and durability. Currently, the cost of fuel cell power systems must be reduced before they can be competitive with conventional technologies (DOE 2011b). At the present time, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation (NRC 2008h). Because fuel cells have not been developed to the point where they are capable of supplying power consistent with the proposed project purpose and need, which is equal to 2200 MW(e), the review team concludes that fuel cell-based electricity generation is not a reasonable alternative to construction and operation of a 2200-MW(e) nuclear power plant supplying baseload electricity.

9.2.4 Combinations of Alternatives

Individual alternatives to the construction of one or more new nuclear units at the proposed site might not be sufficient on their own to generate Duke's target value of 2200 MW(e) because of the small size of the resource or lack of cost-effective opportunities. It is conceivable, however, that a combination of alternatives might be capable of meeting both the baseload and capacity targets of proposed project. There are many possible combinations of alternatives. It would not be reasonable to examine every possible combination of energy alternatives in an EIS. Doing so would be counter to CEQ's direction that an EIS should be analytic rather than encyclopedic, shall be kept concise, and shall be no longer than absolutely necessary to comply with NEPA and CEQ's regulations (40 CFR 1502.2(a)(c)). Given that the stated objective is for a baseload power-generation facility of significant capacity, a fossil energy source, most likely coal or natural gas, would need to be a significant contributor to any reasonable alternative energy combination. Accordingly, the following evaluation has a significant capacity contribution from NGCC power plants as part of the combination of alternatives due to its overall lower overall environmental impact when compared to a similar capacity of coal-fired power generation. The evaluation is conducted using 2024 as the target date for implementation acknowledging that the capacity must be capable of displacing the proposed project in that timeframe.

The selection of combined alternatives is reflective of capacity resources determined to be within the proposed region, or supported through review and analysis of programmatic goals of the applicant, regional, or State policies. The review team also considered that Duke has indicated it is aggressively pursuing renewable energy capacity resources and that the likelihood of growth in this capacity area may be limited beyond the growth that Duke is already planning.

In proposing the capacity from a combination of alternatives, the review team first considered which resource portfolio(s) Duke had presented to the utility commission in the State of North Carolina and South Carolina via the 2012 IRP. Additionally, the review team considered State and regional programs and policies for the development of renewable resources, such as the North Carolina REPS, and prior investigations into the availability and potential for development of alternative energy resources such as the *Analysis of Renewable Energy Potential in South Carolina* (LaCapra Associates 2007), and the *Analysis of a Renewable Portfolio Standard for the State of North Carolina* (LaCapra Associates 2006). The following combination of alternatives reflects capacity that can either be reliably delivered to the power system, or would enable an empiric reduction in the need for additional capacity as would be the case for deployed EE programs. The review team also noted that these resources would be required to directly replace the proposed project, and would necessarily be offered as additions to those resources already presented in the 2012 IRP. As such, any new proposed combination of alternatives would need to meet the capacity projections of the proposed project which are estimated to be approximately 17,345 GWh annually; derived from a 2200-MW(e) nuclear power plant operating at a 90 percent capacity factor.

For the combination of energy alternatives, the staff assumes further expansion of EE programs that will add 616 MW(e) of additional energy savings between 2012 and 2024. The 616 MW(e) of new energy efficiency programs is the difference between what is currently provided in the Duke 2012 IRP forecast for new EE programs of 785 MW(e) in 2024, and the “High EE Case” which offers 1401 MW(e) of new energy efficiency programs in 2024 (Duke 2012a). Because the High EE Case was considered by Duke as part of its IRP, it is reasonable to conclude that the implementation of these programs is possible although it is not being executed at this time. For the purposes of this analysis, it is assumed that 100 percent of the impact of the EE programs would be observed leading to a reduction in energy requirements of 5396 GWh annually.

The Duke 2012 IRP also projects the addition of 2820 MW of gas-fired generation, 341 MW of wind, 719 MW of solar, and 141 MW of biomass between 2012 and 2023, for a total of 4021 MW installed capacity. For the combination of alternatives, the staff assumes that further capacity additions would be made in the same ratios. For the renewable sources, this yields additions of 129 MW(e) of wind, 271 MW(e) of solar, and 53 MW(e) of biomass, for a total of 453 MW(e).

The selected combination of alternatives is consistent with the supply portfolio evaluated in the Duke 2012 IRP (Duke 2012a), represented predominantly by new renewable energy resources, new EE implementation, and new baseload-capable power plants noting that new DSM programs are not included because they are not recognized by the State of North Carolina as meeting the REPS requirements. The review team makes no assumptions regarding how the capacity is developed (either through self-build or purchase), transmitted, or distributed, and rather focuses on resource availability and plausibility.

The review team then considered how much energy might be produced from the additional 453 MW(e) of renewable energy sources, recognizing that the additional capacity is weighted toward resources with lower capacity factors (i.e., wind and solar). Considering the capacity factors, the review team determined that the additional renewable energy alternatives could produce approximately 1326 GWh.

The remainder of the energy required would be expected to come from NGCC given its lower environmental impact compared to other fossil-based facilities. The total energy required from

NGCC would therefore be equal to 10,623 GWh representing the difference between the proposed project and the other resources (EE and renewable energy):

Proposed project:	17,345 GWh
Energy Efficiency:	-5396 GWh
Renewables:	-1326 GWh
NGCC	10,623 GWh

The NGCC units would provide a portion of the baseload power and also make up for any shortfall in power generation when the intermittent sources (wind and solar) are not generating at full capacity. The EE component of this alternative acts like baseload capacity, and the biomass component operates as a baseload source. Subtracting these two components from the 2200 MW(e) intended for the nuclear units, leaves roughly 1530 MW(e) as the installed capacity of the NGCC units. Using NGCC as a baseload alternative capable of high capacity factors, the review team determined that the 10,623 GWh could be satisfied by three NGCC facilities of approximately 510 MW(e) each, operating at an average capacity factor of about 79 percent. In reducing the energy delivered by the NGCC plant by approximately 39 percent from that presented in Section 9.2.2.2, the review team acknowledges that Make-Up Pond C may not be required to support this level of generating capacity at the Lee Nuclear Station site. However, the review team considered that environmental impacts are likely to be noticeable for land-use and ecology impact categories due to the significant build-out of renewable energy sources as well as any remaining biomass-based capacity resources, which would not be co-located at the Lee Nuclear Station site.

For a combination of alternative energy sources, the review team assessed the potential environmental impacts of increasing EE over 78 percent, and increasing the renewable portfolio by more than 35 percent over that which is already offered in the Duke 2012 IRP (Duke 2012a) for 2024. Additionally, the review team considered the environmental impacts of using NGCC to provide the remainder of the energy required. A summary of the environmental impacts associated with the construction and operation of this combination of alternatives is found in the following Table 9-3.

Table 9-3. Summary of Environmental Impacts of a Combination of Power Sources

Impact Category	Impact	Comment
Land use	MODERATE	Natural gas-fired power plants would have land-use impacts for the power block, new transmission-line rights-of-way, cooling towers and support systems, and connection to a natural-gas pipeline. Land would be required for even a smaller version of Make-Up Pond C. Significant build-out of renewable energy resources would require facilities, fuel production and harvesting, and associated transmission lines that would have noticeable land-use impacts.

Table 9-3. (contd)

Impact Category	Impact	Comment
Air quality	SMALL to MODERATE	Based on the difference in energy generated, emissions from natural-gas-fired capacity are 61 percent of that considered in Section 9.2.2.2, and would be approximately: SO_2 – 19 T/yr NO_x – 334 T/yr CO – 127 T/yr PM_{10} – 64 T/yr CO_2 – 3,717,000 T/yr. The combustion of biomass and/or other solid wastes would have emissions. In consideration of EPA regulations regarding PSD permitting, the preceding emissions would be regulated as a "major" new source and are therefore a MODERATE impact for those constituents.
Water use and quality	SMALL	Impacts would be comparable to the impacts for a new nuclear power plant located at the proposed site.
Ecology	MODERATE	Many of the onsite impacts would occur in areas that were previously disturbed during the construction of the Cherokee Nuclear Station. Thus, potential habitat loss and fragmentation and reduced productivity and biological diversity would likely be minimal at the site, but would likely increase dependent on the siting, construction, and operation of biomass, wind, and other renewable energy sources, which would not be co-located on the site.
Waste management	SMALL	Waste would be produced from spent SCR catalyst used for control of NO_x emissions, and ash and slag from biomass and municipal solid-waste sources.
Socioeconomics	MODERATE (adverse) to MODERATE (beneficial)	Construction and operations workforces would be relatively small because of the reliance upon natural-gas generation. Additions to the local tax base, while smaller than for a nuclear or coal-fired plant, might still be noticeable. Some construction-related impacts would be noticeable. Impacts during operation would be minor because of the small workforce involved. The significant build-out of renewable power-generation facilities and the associated transmission lines would have aesthetic impacts.
Human health	SMALL	Regulatory controls and oversight would be protective of human health.
Historic and cultural resources	MODERATE	Most of the facilities and infrastructure at the site would likely be built on previously disturbed ground. Impacts resulting from ground-disturbance and visual intrusions would likely increase dependent on the siting, construction, and operation of renewable power-generation facilities, which would not be co-located on the site.

Table 9-3. (contd)

Impact Category	Impact	Comment
Environmental justice	SMALL	The review team identified no pathways by which a disproportionately high and adverse impact could be imposed upon any minority or low-income populations within the 50-mi region.

9.2.5 Summary Comparison of Energy Alternatives

Table 9-4 contains a summary of the review team's environmental impact characterizations for constructing and operating new nuclear, coal-fired, and natural-gas-fired combined-cycle units at the proposed site. The combination of alternatives shown in Table 9-4 assumes siting of natural-gas-fired, combined-cycle units at the proposed site and the siting of other generating units in the general vicinity (within 100 mi) of the site, or as locations mandate. Closed-cycle cooling with natural draft or mechanical cooling towers is assumed for all thermal plants.

Table 9-4. Summary of Environmental Impacts of Construction and Operation of New Nuclear, Coal-Fired, and Natural-Gas-Fired Generating Units, and a Combination of Alternatives

Impact Category	Nuclear[(a)]	Coal	Natural Gas	Combination of Alternatives
Air quality	SMALL	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Waste management	SMALL	MODERATE	SMALL	SMALL
Human health	SMALL	SMALL	SMALL	SMALL
Land use	MODERATE	MODERATE	MODERATE	MODERATE
Water use and quality	SMALL	SMALL	SMALL	SMALL
Ecology	MODERATE	MODERATE	MODERATE	MODERATE
Socioeconomics	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to MODERATE (beneficial)	MODERATE (adverse) to MODERATE (beneficial)
Historic and cultural resources	MODERATE	MODERATE	MODERATE	MODERATE
Environmental justice	SMALL	SMALL	SMALL	SMALL

(a) For nuclear, conclusion reflects conclusions presented in Chapters 4 and 5, and Sections 6.1 and 6.2.

The distinguishing impacts are primarily related to emissions from the alternative generation sources (air quality). For the energy-generation alternatives discussion, emissions are bounded by a review of criteria pollutants and the total tons produced. Accordingly, the coal-fired alternative produces the highest level of criteria pollutants and total air emissions; in total tons, the highest percentage of regulated emissions comes from the release of sulfur during the combustion process followed by NO_X and CO also due to the combustion of coal with air (oxygen). These pollutants can also lead to the development of PM. The natural-gas-fired alternative produces the next highest level of emissions. With a reasonably clean fuel stream (methane), the primary pollutants are limited to NO_X and CO. Natural gas in combination with renewable resources emits lower quantities of criteria pollutants than the natural-gas-fired alternative. A nuclear plant has less impact on air quality than coal, natural gas, or a combination of alternatives.

With respect to other resource areas, the coal alternative has a greater waste impact than the other alternatives. The nuclear and coal plant alternative provides the greatest economic benefits to Cherokee County. While the natural-gas alternative has the least adverse socioeconomic impact for the plant itself, considering the construction and operation of transmission lines, the impacts on aesthetics are similar to coal and nuclear alternatives. Overall, the review team concludes that none of the energy alternatives is environmentally preferable to the proposed Lee Nuclear Station.

It is appropriate to specifically discuss the differences among the alternative energy sources regarding CO_2 emissions. The CO_2 emissions for the proposed action and energy-generation alternatives are discussed in Sections 5.7.2, 9.2.2.1, 9.2.2.2, and 9.2.4. Table 9-5 summarizes the CO_2 emission estimates for a 40-year period for the alternatives considered by the review team to be viable for baseload power generation. These estimates are limited to the emissions from power generation and do not include CO_2 emissions for workforce transportation, construction, fuel cycle, or decommissioning. Among the viable energy-generation alternatives, the CO_2 emissions for nuclear power are a small fraction of the emissions of the other viable energy-generation alternatives.

Table 9-5. Comparison of Direct Carbon Dioxide Emissions for Energy Alternatives

Generation Type	Years	CO_2 Emission (MT)
Nuclear power[(a)]	40	380,000
Coal-fired generation[(b)]	40	760,000,000
Natural-gas-fired generation[(c)]	40	243,000,000
Combination of alternatives[(d)]	40	149,000,000

(a) From Section 5.7.2, value is for two units.
(b) From Section 9.2.2.1.
(c) From Section 9.2.2.2.
(d) From Section 9.2.4 (assuming only natural-gas generation has significant CO_2 emissions).

On June 3, 2010, the EPA issued a rule tailoring the applicability criteria that determines which stationary sources and modifications to existing projects become subject to permitting requirements for greenhouse gas emissions under the PSD and Title V programs of the Clean Air Act (Ref 75 FR 31514). According to the Tailoring Rule, greenhouse gas is a regulated new source review (NSR) pollutant under the PSD major source permitting program if the source (1) is otherwise subject to PSD (for another regulated NSR pollutant) and (2) has a greenhouse gas potential to emit equal to or greater than 75,000 T/yr of carbon dioxide equivalent (CO_2e) (adjusting for different global warming potentials for different greenhouse gases). Such sources would be subject to BACT. The use of BACT has the potential to reduce the amount of greenhouse gases emitted from stationary source facilities. The implementation of this rule could reduce the amount of greenhouse gases from the values indicated in Table 9-5 for coal and natural gas, as well as from other alternative energy sources that would otherwise have appreciable uncontrolled greenhouse gas emissions. The emission of greenhouse gases from the production of electrical energy from a nuclear power source is multiple orders of magnitude less than those of the reasonable alternative energy sources. Accordingly, the comparative relationship between the energy sources listed in Table 9-5 would not change meaningfully because greenhouse gas emissions from the other energy source alternatives would not be sufficiently reduced to make them environmentally preferable to the proposed project.

Considering the addition of life-cycle greenhouse gas emissions from the production of electricity from a nuclear power source, i.e., those from the fuel cycle and transportation of workers, total emissions for plant operation over a 40-year period would increase to about 54,000,000 MT. This amount is still significantly lower than the emissions from any of the other alternatives; such emissions could be reduced further if the electricity from the assumed fossil fuel source powering the fuel cycle is subject to BACT controls.

CO_2 emissions associated with generation alternatives such as wind power, solar power, and hydropower would be associated with workforce transportation, construction, and decommissioning of the facilities. Because these generation alternatives do not involve combustion, the review team considers the emissions to be minor and concludes that the emissions would have a minimal impact. Other energy-generation alternatives involving combustion of oil, wood waste, municipal solid waste, or biomass-derived fuels would have CO_2 emissions from combustion as well as from workforce transportation, plant construction, and plant decommissioning. It is likely that the CO_2 emissions from the combustion process for these alternatives would dominate the other CO_2 emissions associated with the generation alternative. It is also likely that the CO_2 emissions from these alternatives would be the same order of magnitude as the emissions for the fossil fuel alternatives considered in Sections 9.2.2.1 and 9.2.2.2. However, because these alternatives were determined by the review team not to meet the need for baseload power generation, the review team has not evaluated the CO_2 emissions quantitatively.

As discussed in Chapter 8 of this EIS, the review team has concluded that the need for the additional baseload power generation has been demonstrated. Also, as discussed earlier in this chapter, the review team concludes that the viable alternatives to the proposed action all would involve the use of fossil fuels (coal or natural gas) whether singly or in combination with other alternative energy resources. The review team concludes that the proposed action results in the lowest level of emissions of greenhouse gases among the viable alternatives.

9.3 Alternative Sites

The NRC's ESRP (NRC 2000a) states that the environmental report (ER), submitted in conjunction with an application for a COL, should include an evaluation of alternative sites to determine if any obviously superior alternative to the proposed site exists. The NRC's site-selection process guidance calls for identification of a ROI, followed by successive screening to identify candidate areas, potential sites, candidate sites, and the proposed site (NRC 2000a). This section includes a discussion of Duke's ROI for the proposed siting of a new nuclear power plant, and describes its alternative site-selection process. This is followed by the review team's evaluation of the Duke process, a description of the alternative sites selected, and discussion of the environmental impacts of locating the proposed facilities at each alternative site.

The review of alternative sites consists of a two-part sequential test (NRC 2000a). The first part of the test determines whether any of the alternative sites are environmentally preferable. To determine if a site is environmentally preferable, the review team considers whether the applicant has (1) reasonably identified candidate sites, (2) evaluated the likely environmental impacts of the proposed action at these sites, and (3) used a logical means of comparing sites that led to selection of the proposed site. Based on its independent review, the review team determines whether any of the alternative sites are environmentally preferable to the applicant's proposed site. If the review team determines that one or more alternative sites are environmentally preferable, it then proceeds with the second part of the test.

The second part of the test determines if an environmentally preferable alternative site is not simply marginally better, but obviously superior to the proposed site. The review team examines whether (1) one or more important aspects, either singly or in combination, of an acceptable and available alternative site are obviously superior to the corresponding aspects of the applicant's proposed site, and (2) the alternative site does not have offsetting deficiencies in other important areas. Included in this part of the test is the consideration of estimated costs (i.e., environmental, economic, and time of building the proposed plant) at the proposed site and at the environmentally preferable site or sites (NRC 2000a).

This section describes Duke's site-selection process, the review team's evaluation of the Duke process, the alternative sites selected by Duke, and the review team's evaluation of the environmental impacts of locating two new nuclear generating units at each alternative site.

The specific resources and components that could be affected by the incremental effects of the proposed action and other actions in the same geographic area were assessed. For the purposes of this alternative sites evaluation, impacts evaluated include NRC-authorized construction, operation, and other cumulative impacts including preconstruction activities. Sections 9.3.3 through 9.3.5 provide a site-specific description of the environmental impacts at each alternative site based on issues such as land use, water resources, terrestrial and aquatic ecology, socioeconomics, environmental justice, historic and cultural resources, air quality, nonradiological health, radiological impacts of normal operation, and postulated accidents. Section 9.3.6 contains a table of the review team's characterization of the impacts at the alternative sites and comparison with the proposed site to determine if there are any alternative sites that are environmentally preferable to the proposed site.

9.3.1 Alternative Site-Selection Process

Duke used guidance provided in the NRC's ESRP (NRC 2000a), NRC Regulatory Guide 4.7, Revision 2 (NRC 1998), and the Electric Power Research Institute Siting Guide (EPRI 2002). The site-selection and comparison process focused on identifying and evaluating sites that represented an acceptable range of alternatives for the proposed Lee Nuclear Station Units 1 and 2. The following information details the process deployed to strategically identify and screen sites in successive steps until a reasonable number of alternative sites were determined and evaluated, and the proposed Lee Nuclear Station site was selected (Duke 2009c).

Duke's screening process proceeded through the following steps, which successively reduced the number of sites down to the final candidate sites (Duke 2009c):

- ROI: Largest geographic area of consideration generally defined as either the State in which the applicant proposes to build, or the relevant service area of the applicant.
- Candidate Areas: Areas within the ROI that would support the facility as proposed. These areas were determined by using exclusionary and/or avoidance criteria to screen the ROI to eliminate those areas where it would not be feasible to site a nuclear facility due to regulatory, institutional, plant design, and/or significant environmental impacts.
- Potential Sites: Discrete parcels of land found within the candidate areas that would support the facility as proposed. Potential sites were determined by using a refined set of exclusionary and/or avoidance criteria to screen the candidate areas. The screening data set was more refined and of higher detail than the data set used to identify the candidate areas.
- Candidate Sites: Sites that were selected by applying suitability criteria to the potential site list. This selection process used a quantifiable weighting and ranking process, including sensitivity analysis.
- Proposed Site(s): Identification of the proposed site from the list of candidate sites was done on an issue-by-issue basis that allowed the applicant to identify both cost and

environmental trade-offs associated with developing each of the candidate sites. This approach provided a high level of assurance that the proposed site had no fatal flaw that could result in environmental impacts outside the identified scope, licensing delays, or increased cost.

The identification and validation of the final proposed site was done on an issue-by-issue basis, allowing the applicant to identify the cost and environmental trade-offs associated with developing each one of the candidate sites (Duke 2009c).

ESRP 9.3 (NRC 2000a) recognizes the potential value of including existing nuclear power plant sites that were "previously found acceptable on the basis of a National Environmental Policy Act (NEPA) review, or have [been] demonstrated to be environmentally acceptable on the basis of operating experience, or allocated to an applicant by a state government from a list of state-approved power plant sites." Of the four final candidate sites, both the Lee Nuclear Station site (former Cherokee Nuclear Station site) and Perkins site met the preceding criteria of having been found previously acceptable after a NEPA review. The review team notes that previous determinations of site acceptability do not exempt that site from the same level of rigor of evaluation applied to the other alternative sites. The ESRP simply recognizes that a significant level of site characterization may have already been conducted thereby providing a reasonable basis for assessment.

To aid in the screening and evaluation of alternative sites, several Duke business-specific considerations were evaluated and incorporated into the siting analysis as "bounding conditions". They include the following:

- The alternative sites must be suitable for design parameters of the specific reactor and plant design as certified by the NRC; sites should be identified in both North Carolina and South Carolina that are suitable for nuclear power plants.
- The location must be compatible with Duke's current transmission capabilities, and provide baseload power to the primary load centers in the Duke ROI with minimal loss.
- The selected sites' expected characterization, licensing, and regulatory potential must minimize schedule and financial risk.
- Compliance with all NRC and other requirements.

As a regulated utility with a franchised service area, Duke defined its ROI as consisting of its franchised service area, which is consistent with the guidance in the NRC's ESRP (NRC 2000a). The review team concludes that the ROI used in Duke's application is reasonable for consideration and analysis of candidate areas and sites. The review team also finds that Duke's basis for defining its ROI did not arbitrarily exclude or include desirable locations.

Duke screened the ROI using applicable exclusionary and avoidance criteria, as identified in the Electric Power Research Institute's Siting Guide (EPRI 2002). Using the following seven criteria: seismic/geology, population density, water availability, dedicated land use, regional ecological features, proximity to high-voltage transmission and load centers, and access to rail lines; Duke's initial screening yielded six candidate areas, which included two in North Carolina, three in South Carolina, and one that extended across both States. Figure 9-1 shows the ROI and the six candidate areas (termed "Regional Screening Areas" in the figure).

To identify potential sites from within the candidate areas, Duke deployed a two-track process. In the first track, Duke reviewed previous siting studies completed for both nuclear and fossil-fuel plants within the candidate areas. Seventeen total potential sites were identified within the candidate areas; the list included the three nuclear power stations owned and operated by Duke: Catawba Nuclear Station, Oconee Nuclear Station, and McGuire Nuclear Station. Due to site-specific land-use restrictions, expanding population growth, and/or additional challenges, all three sites were dropped from further consideration. However, a potential site adjacent to the Oconee Nuclear Station (termed the Keowee site) was identified through application of rough-screening criteria that capitalized on aspects of being located in close proximity to a nuclear station, though not physically co-located. This provided 15 total potential sites. Five sites were screened out due to significant residential development in the area, reducing the list to 10 potential sites.

The second track was a secondary and completely discrete siting exercise using a geographic basis to evaluate the candidate areas for potential sites. This siting activity applied criteria such as population and development avoidance; proximity to transportation, transmission, and load centers; diversity among sites representing both South Carolina and North Carolina; and maintaining as available, one potential site for each major water source. Thirteen potential sites were identified in this independent activity. The 13 potential sites were consolidated with the 10 potential sites identified by Duke in its previous siting analysis. Eight of the 23 combined list sites were duplicates, which left a final list of 15 potential sites for continued evaluation.

A two-phase process involving coarse screening followed by fine screening was then used to evaluate the 15 potential sites. In the first (coarse) evaluation, the 15 potential sites were assessed against 9 coarse screening criteria by assigning weighting and ranking factors to each site in 9 key criteria areas, including 6 environmental criteria and 3 cost criteria. The nine coarse screening criteria included water supply availability, flooding potential, distance to population centers, known hazardous land uses near the site, protected species or habitat near the site, acres of identified wetlands on the site, cost to construct access to nearest rail line, cost to construct transmission to nearest transmission node, and land acquisition costs. This evaluation provided a composite score for each site reflective of overall suitability. A total of seven potential sites were carried forward for fine screening.

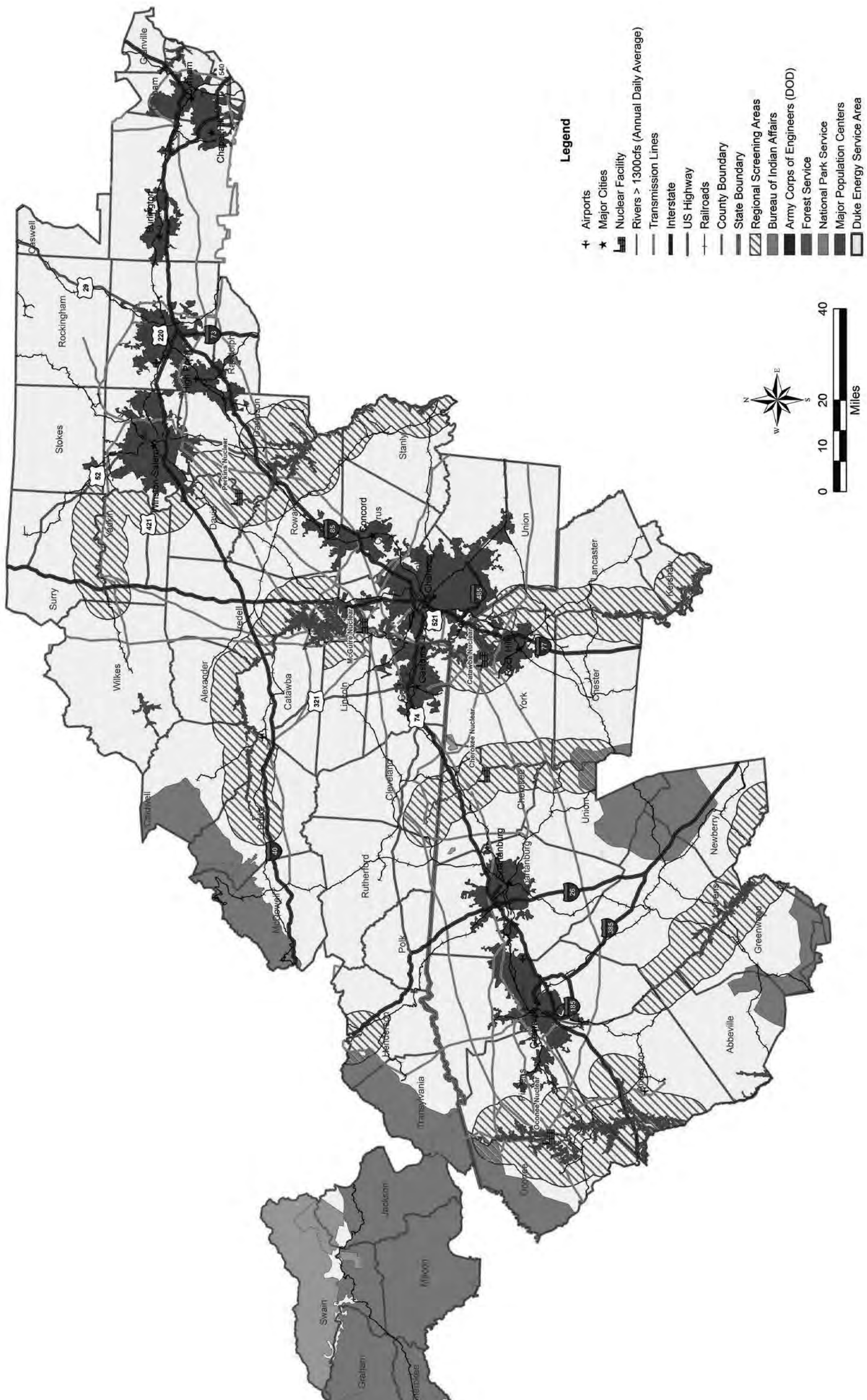

Figure 9-1. Duke ROI Showing Regional Screening Results (Duke 2009c, Figure 9.3-3)

In the second (fine) evaluation, the remaining seven potential sites were then assessed against fine screening criteria using an expanded set of over 40 site-specific suitability criteria. The detailed evaluation and final composite scores of the seven remaining potential sites yielded a quantified evaluation that enabled the selection of the final proposed site and three alternative sites.

Using the process described above, Duke identified the Lee Nuclear Station site as its proposed site along with three alternative sites for detailed comparative evaluation, including (Duke 2009c):

- Perkins site (previously considered for the Perkins Nuclear Station), Davie County, North Carolina
- Keowee site (adjacent to Oconee Nuclear Station), Oconee County, South Carolina
- Middleton Shoals site, Anderson County, South Carolina.

Of the three alternative sites, all are greenfield sites. One, the Perkins site, was previously characterized for the siting of a nuclear power plant that was never built. In the final application of screening criteria, Duke considered aspects of both environmental impact and cost. The review team considered only environmental matters in its determination of whether an alternative site was environmentally preferable to the proposed site and did not consider non-environmental issues, such as constructability and cost. The review team recognizes, however, that in some cases environmental and cost factors are related. So, for example, a site that requires longer transmission lines will have both higher environmental impacts and higher costs related to those transmission lines.

9.3.2 Review Team Evaluation of Duke’s Alternative Sites

The review team evaluated the methodology used by Duke and concluded that the process was reasonable and consistent with the guidelines presented in the ESRP and the EPRI Siting Guide. The review team found that the systematic alternative siting analysis demonstrated a logical selection process and application of screening and exclusionary siting criteria. The analysis enabled the evaluation of the likely environmental impacts associated with the respective sites, including the evaluation of suitability criteria; identified acceptable alternative sites; and clearly provided the mechanism for selection of the final proposed site.

Following the guidance provided in ESRP 9.3 (NRC 2000a), the review team visited the three alternative sites and collected and analyzed reconnaissance-level information for each. The review team then used the information in the ER and responses to requests for additional information (RAIs), information from other Federal and State agencies, and information gathered during the site visits to evaluate environmental impacts of building and operating two new nuclear power plants at those sites. The analysis considered the impacts of

NRC-authorized construction and operation as well as potential cumulative impacts associated with other actions affecting the same resources, including but not limited to preconstruction. The cumulative impact analysis for the alternative sites was performed in the same manner as discussed in Chapter 7 for the proposed site except, as specified in ESRP 9.3 (NRC 2000a), the analysis was conducted at the reconnaissance level. The review team researched EPA databases for recent EISs within the State; used an EPA database for permits for water discharges in the geographic area to identify water-use projects; and used www.recovery.gov to identify projects in the geographic area funded by the American Recovery and Reinvestment Act of 2009 (ARRA). The review team developed tables of the major projects near each alternative site that were considered relevant in the cumulative analysis. The review team used the information to perform an independent evaluation of the direct, indirect, and cumulative impacts of the action at the alternative sites to determine if one or more of the alternative sites were environmentally preferable to the proposed site.

Included are past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts with the action. For the purposes of this analysis, the past is defined as the time period prior to receipt of the COL application. The present is defined as the time period from the receipt of the COL application until the beginning of NRC-authorized construction of proposed Units 1 and 2. Future actions are those that are reasonably foreseeable through NRC-authorized construction and operation of the proposed Units 1 and 2 and decommissioning.

The specific resources and components that could be affected incrementally by the action and other actions in the same geographic area were identified. The affected environment that serves as the baseline for the cumulative impacts analysis is described for each alternative site, and a qualitative discussion of the general effects of past actions is included. The geographic area over which past, present, and future actions could reasonably contribute to cumulative impacts is defined and described for each resource area. The analysis for each resource area at each alternative site concludes with a cumulative impact finding (SMALL, MODERATE, or LARGE). For conclusions greater than SMALL, the review team also discussed whether building and operating the proposed facilities would be a significant contributor to the cumulative impact. In the context of this evaluation, “significant” is defined as a contribution that is important in reaching that impact-level determination.

The nonradiological waste impacts described in Sections 4.10 and 5.10 would not substantially vary from one site to another. The types and quantities of nonradiological and mixed waste would be approximately the same for construction and operation of two Westinghouse Advanced Passive 1000 (AP1000) pressurized water reactors at any of the alternative sites. For each alternative site, all wastes destined for land-based treatment or disposal would be transported offsite by licensed contractors to existing, licensed, disposal facilities operating in compliance with all applicable Federal, State, and local requirements. All nonradioactive, liquid discharges would be discharged in compliance with the provisions of the applicable NPDES permit. For these reasons, these impacts are expected to be minimal and will not be discussed separately in the evaluation of each alternative site.

The impacts described in Chapter 6 of this EIS (e.g., nuclear fuel cycle and decommissioning) would likewise not substantially vary from one site to another. This is true because all of the sites are in low-population areas and because the review team assumes the same reactor design (therefore, the same fuel-cycle technology, transportation methods, and decommissioning methods) for all of the sites. As such, these impacts would not differentiate between the sites and would not be useful in the determination of whether an alternative site is environmentally preferable to the proposed site. For this reason, these impacts are not discussed in the evaluation of the alternative sites.

The cumulative impacts are summarized for each resource area in the subsections that follow. The level of detail is commensurate with the potential significance of the impacts. The three alternative sites are described in the following sections: the Perkins site (9.3.3); the Keowee site (9.3.4); and the Middleton Shoals site (9.3.5). A summary comparison of the review team's characterization of the impacts of the proposed action at the proposed and alternative sites is presented in Section 9.3.6 and Table 9-18.

9.3.3 The Perkins Site

This section covers the review team's evaluation of the potential environmental impacts of siting two new nuclear units at the Perkins site located in Davie County, North Carolina. The site was characterized in detail for the Perkins Nuclear Station (Duke Power Company 1974d). The following sections describe a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if it were implemented at the Perkins site, and other actions in the same geographic area were considered. This assessment includes the impacts of NRC-authorized construction, operations, and preconstruction activities. Also included in the assessment are other past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the Perkins site. Other actions and projects considered in this cumulative analysis are described in Table 9-6.

Perkins is a wooded greenfield site located approximately 11 mi north of Salisbury, North Carolina. The Perkins site is wholly owned by Duke, and is maintained as forested land under the direct management of the North Carolina Wildlife Resources Commission. As an undeveloped greenfield site, the site would require significant grading and cut-fill activities to support a two-unit nuclear power facility. Figure 9-2 shows the Perkins site region.

The Perkins site is located in the northeast portion of Duke's service territory in close proximity to U.S. Highways 158 (US-158), US-64, and US-601. Route 801 provides the approximate northern boundary to the site, and the Yadkin River provides portions of the approximate southern boundary. Interstate 85 (I-85) lies approximately 9 mi southeast of the site. The area is predominantly rural. The nearest population centers are Salisbury, North Carolina, which is approximately 11 mi south of the site and Winston-Salem, North Carolina, which is approximately 15 mi northeast of the site.

Table 9-6. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Perkins Alternative Site Cumulative Analysis

Project Name	Summary of Project	Location	Status
Nuclear Energy Projects			
Catawba Nuclear Station Units 1 and 2	Nuclear power generating plant with two 1129-MW(e) Westinghouse pressurized water reactors	Approximately 65 mi southwest of the Perkins site	Catawba Units 1 and 2 are currently operational and licensed through December 5, 2043 (NRC 2012a).
H.B. Robinson Unit 2	Nuclear power generating plant with one 710-MW(e) Westinghouse pressurized water reactor	Approximately 100 mi south-southeast of the Perkins site	H.B. Robinson Unit 2 is currently operational and licensed through July 31, 2030 (NRC 2012a).
McGuire Nuclear Station Units 1 and 2	Nuclear power generating plant with two 1100-MW(e) Westinghouse pressurized water reactors	Approximately 40 mi southwest of the Perkins site	McGuire Units 1 and 2 are currently operational and are licensed through June 12, 2041 and March 3, 2043, respectively (NRC 2012a)
Shearon Harris Nuclear Power Plant Unit 1	Nuclear power generating plant with one 900-MW(e) Westinghouse pressurized water reactor	Approximately 85 mi east of the Perkins site	Shearon Harris Unit 1 is currently operational and licensed through October 24, 2046 (NRC 2012a)
Shearon Harris Units 2 and 3	Nuclear power generating plant with two Westinghouse AP1000 pressurized water reactors	Approximately 85 mi east of the Perkins site	Proposed (NRC 2008l)

Table 9-6. (contd)

Project Name	Summary of Project	Location	Status
Coal and Natural Gas Energy Projects			
Buck Steam Station	The 256-MW coal-fired generating plant operated by Duke Energy was permanently shut down in April 2013.	Approximately 10 mi south-southeast of the Perkins site	Ceased operations (Duke 2013d)
Buck Combined-Cycle Station	A 620-MW combined-cycle natural-gas plant on the Buck Steam Station site began operations in 2011.	Approximately 10 mi south-southeast of the Perkins site	Operational (Duke Energy 2013c)
Plant Rowan	A 925-MW natural-gas-fired generating plant operated by Southern Power	Approximately 12 mi southwest of the Perkins site	Operational (Southern Power 2013)
Marshall Steam Station	A 2090-MW coal-fired generating plant operated by Duke Energy	Approximately 34 mi west-southwest of the Perkins site	Operational (Duke Energy 2010h)
Belews Creek Steam Station	A 2240-MW coal-fired generating plant operated by Duke Energy	Approximately 37 mi northwest of the Perkins site	Operational (Duke Energy 2010i)
Riverbend Steam Station	A 454-MW coal-fired generating plant operated by Duke Energy was permanently shut down in March 2013	Approximately 45 mi southwest of the Perkins site	Ceased operations (Duke 2013d)
Rockingham Station	A 825-MW natural-gas-fired plant operated by Duke Energy	Approximately 48 mi northwest of the Perkins site	Operational (Duke Energy 2010k)
Various small-scale fossil and cogeneration generating facilities such as the City of Winston-Salem landfill gas-to-energy project	Fossil-fuel-fired and cogeneration facilities ranging from 1-11 MW	In North Carolina and South Carolina throughout the 50-mi region	Operational (Landfill Energy Systems 2013) and Proposed (NCDENR 2010a)

Table 9-6. (contd)

Project Name	Summary of Project	Location	Status
Hydroelectric Energy Projects			
Yadkin Project	A series of four hydroelectric generating stations including Falls (29.94 MW), Narrows (108.8 MW), Tuckertown (38.04 MW), and High Rock (39.6 MW). Operated by Alcoa Power Generating, Inc.	On the Yadkin River between 21 mi and 38 mi southeast and downstream of the Perkins site	Operational (Alcoa 2010)
Lookout Shoals	A 26-MW hydroelectric plant operated by Duke Energy	Approximately 36 mi west of the Perkins site	Operational (Duke Energy 2010l)
Cowans Ford	A 350-MW hydroelectric plant operated by Duke Energy	Approximately 40 mi southwest of the Perkins site	Operational (Duke Energy 2010m)
Oxford	A 36-MW hydroelectric plant operated by Duke Energy	Approximately 42 mi west of the Perkins site	Operational (Duke Energy 2010n)
Mountain Island	A 60-MW hydroelectric plant operated by Duke Energy	Approximately 46 mi southwest of the Perkins site	Operational (Duke Energy 2010o)
Tillery Hydroelectric Plant	An 86-MW hydroelectric plant operated by Duke Energy	Approximately 49 mi south-southeast of the Perkins site	Operational (Duke Energy 2013d)
Various small-scale hydroelectric projects located on dams, including the Mayo project.	Run-of-river and dam storage hydroelectric projects ranging up to 1.2 MW.	In North Carolina and South Carolina throughout the 50-mi region	Operational (NCDENR 2010b)
Transportation Projects			
Winston-Salem Northern Beltway	Multi-lane freeway that will loop around the northern part of Winston-Salem	Winston-Salem, NC, approximately 14 mi north-northwest of the Perkins site	Proposed (NCDOT 2010)
NC 109 Improvement Project	Improvements to NC 109 from Old Greensboro Road (SR 1798) in Davidson County to I-40/US 311 in Forsyth County.	Winston-Salem, NC, approximately 16 mi northeast of the Perkins site	Proposed (NCDOT 2013)

Table 9-6. (contd)

Project Name	Summary of Project	Location	Status
LYNX Blue Line Extension Northeast Corridor Light Rail Project	An 11-mi-long extension of the light rail system	Charlotte, NC, approximately 39 mi south-southwest of the Perkins site	Proposed (CATS 2010)
Parks and National Forests			
Boone's Cave Park	100-ac park on Yadkin River	Approximately 4 mi south of the Perkins site	Managed by Davidson Co. Recreation and Parks Department (Davidson County 2009)
Tanglewood Park	Fishing ponds, picnic area, gardens, and trails at former estate	Approximately 11 mi north of the Perkins site	Managed by Forsyth County
Uwharrie National Forest	50,645-ac national forest.	Approximately 28 mi southeast of the Perkins site	Currently managed by U.S. Forest Service (USFS 2013)
Other State parks, forests, and wilderness areas	Numerous State Parks, Wildlife Management Areas, and Wilderness Areas including Boone's Cave State Park, Lake Norman State Park, Pilot Mountain State Park, Hanging Rock State Park, and Daniel Boone State Park	Throughout the 50-mi region	Development likely limited in these areas (NCDPR 2010)
Other Actions/Projects			
PPG Industries Fiber Glass Products	Pressed and blown glassware manufacture	Approximately 10 mi southeast of the Perkins site	Operational PPG: (EPA 2010ae)
Arteva Specialties Kosa Salisbury Plant	Plastic manufacture	Approximately 12 mi southwest of the Perkins site	Operational ARTEVA: (EPA 2010af)
Tyson Foods	Animal food processing	Approximately 17 mi northwest of the Perkins site	Operational Tyson: (EPA 2010ag)
Thomasville Furniture Plant	Sawmills and Planing Mills	Approximately 21 mi east of the Perkins site	Operational Thomasville: (EPA 2010ah)

Table 9-6. (contd)

Project Name	Summary of Project	Location	Status
Various hospitals	Medical isotopes	Within 50 mi of the Perkins site	Operational in nearby cities and towns
Surface mines including the Martin Marietta, Carolina Sand Company, Vulcan Materials, and Carolina Quarries	Surface mining operations for construction materials	Various locations within the 50-mi region	Operational Martin Marietta: (EPA 2010ai) Carolina Sand: (EPA 2010aj) Vulcan: (EPA 2010ak) Carolina Quarries: (EPA 2010al)
Minor water dischargers and wastewater-treatment plants	NPDES-permitted municipal and industrial discharges	Throughout the 50-mi region	Operational
Commercial dairies and poultry farms including Spencer Poultry, Beeson Poultry, Hampton Poultry, Mountaire Farms, and Buttke Dairy Enterprises	Commercial production of animal products	In North Carolina and South Carolina throughout the 50-mi region	Operational in surrounding areas
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and railroad; construction of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents	Throughout region.	Construction would occur in the future, as described in State and local land-use planning documents

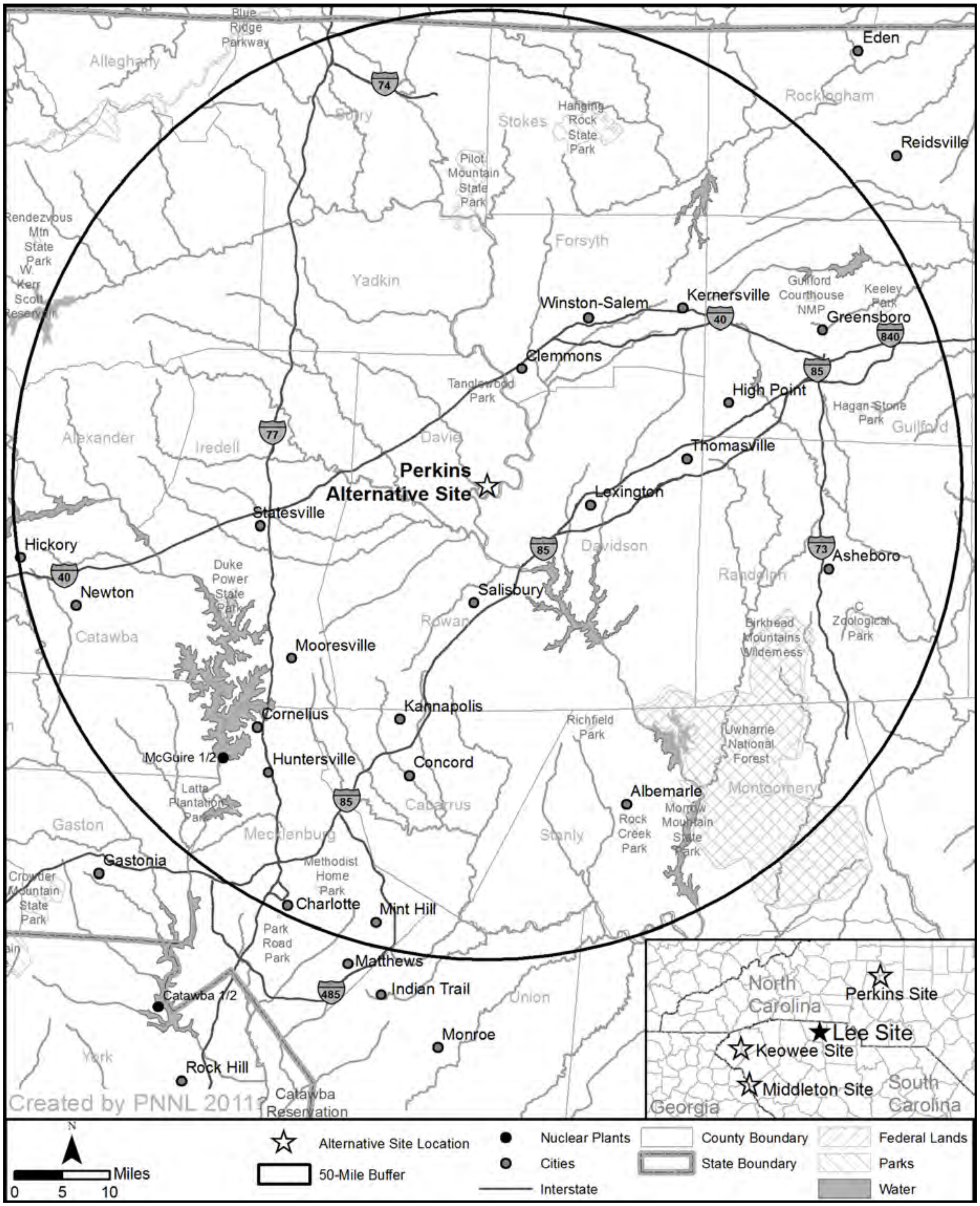

Figure 9-2. The Perkins Site Region

9.3.3.1 Land Use

The following analysis addresses impacts on land use from building and operating the proposed facilities at the Perkins site in Davie County, North Carolina. In addition to land-use impacts from building and operations, the cumulative analysis for the Perkins site considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative land-use impacts, including other Federal and non-Federal projects and the projects listed in Table 9-6.

Site Description

The Perkins site is located in Davie County near the north-central border of North Carolina on the Yadkin River. The land was originally slated for the Perkins Nuclear Station in the 1970s but is now managed as game land by the North Carolina Wildlife Resources Commission under an agreement with Duke (NCWRC 2011a). The site grade elevation is between 720 and 730 ft with a maximum flood elevation of 650 to 660 ft; therefore there are no flood plains on the site (Duke 2009c). The site is not in the coastal zone. The area around the site is undergoing moderate residential development (Duke 2009c), especially near the proposed location of the three supplemental water reservoirs. Access to the site is off Route 801 to the north, which connects to US-601 and US-64 (Duke 2009c).

Building and Operation Impacts

As an undeveloped greenfield site, the Perkins site would require extensive grading and cut-fill activities to support a two-unit nuclear power facility. Development would require about 450 ac onsite (Duke 2009c) and approximately 1500 ac offsite for three supplemental water reservoirs (Duke 2010g). If the proposed project were to be built on the Perkins site, all or much of the site could no longer be managed by North Carolina Wildlife Resources Commission as game land. Table 9-7 summarizes expected land-use impact parameters for the Perkins site, supplemental water reservoirs, and ancillary facilities.

Table 9-7. Land-Use Impact Parameters for the Perkins Site

Parameter	Value	Source
Required project area	450 ac	Duke (2009c)
Number of supplemental water reservoirs	3	Duke (2009b)
Supplemental water reservoirs, area required	1500 ac	Duke (2010g)
Ancillary facilities	250 ac	Duke (2010g)
Number of new transmission-line routes	2	Duke (2010g)
Total transmission-line corridor distance (270-ft-wide corridor)	5.2 mi	Duke (2010g)
Railroad spur distance (100-ft-wide corridor)	6.3 mi	Duke (2010g)
Cooling-water pipeline (50-ft-wide corridor)	7.7 mi	Duke (2010g)

Duke estimates two transmission lines (2.4 mi and 2.8 mi) totaling 5.2 mi, each with a 270-ft corridor, would be needed to connect the site with the transmission system (Duke 2010g). Where possible, Duke would avoid populated areas and residences; however, land currently used for forests or timber production would be altered, replaced with grasses and other types of ground cover (Duke 2009c). A 6.3-mi railroad spur would have to be built to support construction deliveries, and a 7.7-mi pipeline would have to be built to convey cooling water (Duke 2010g). The review team concludes that the land-use impacts of building and operating two new nuclear power units at the Perkins site would be noticeable but not destabilizing.

Cumulative Impacts

For the analysis of cumulative land-use impacts, the geographic area of interest is considered to be the 50-mi region centered on the Perkins site, which includes all associated proposed transmission-line corridors (Figure 9-2). Land-use planning for transmission-line routing over wide areas must consider the land-use plans of adjoining counties and other land-managing agencies, rather than considering one county in isolation. Furthermore, in predominantly rural settings such as that surrounding the Perkins site, land-use changes occurring substantial distances away from a project site can substantially influence land-use planning decisions close to the site. Roads and other public facilities and services in rural areas tend to serve people who are spread thinly but broadly over large portions of the landscape. Therefore, land-use changes can affect roads and other facilities at greater distances than similar changes in more densely populated areas.

The proposed project would indirectly result in land conversions to residential areas, roads, and businesses to accommodate growth, new workers, and services related to the proposed nuclear facility. Other reasonably foreseeable projects in the area that could contribute to an increase in urbanization include potential development of new residences within easy commuting distance of the new plant and the development and upgrading of local roads and highways. Because the other projects described in Table 9-6 do not include reasonably foreseeable substantial changes in land-use types within 50 mi of the Perkins site, other than general growth and urbanization development discussed above, there would not be any significant additional cumulative impacts on land use from those activities.

As described above, building the proposed facilities, development of new transmission-line corridors, inundation of land for supplemental water reservoirs, and building the water intake and railroad spur to support the new units may affect more than 2200 ac of land. The overall land-use impacts of these activities would be regionally noticeable and permanent. If additional transmission lines were built for other energy projects developed within the geographic area of interest, there would be a cumulative land-use impact from the additional amount of land converted to utility corridor use for transmission lines. Because new transmission lines are often co-located with existing utility lines, the review team expects that the cumulative impact would be consistent with the land-use plans and zoning regulations of the affected counties.

Nonetheless, consistent with previous discussions, multiple new transmission-line corridors could noticeably alter land use within the geographic area of interest.

Due primarily to the extensive acreage required for development of the project, the review team concludes that the cumulative land-use impacts would be MODERATE. Considering the land needs noted above, building and operating two new nuclear units at the Perkins site would be a significant contributor to these impacts.

9.3.3.2 Water Use and Quality

This section describes the review team's assessment of impacts on water use and quality associated with building and operating two new nuclear units at the Perkins site. The assessment considers other past, present, and reasonably foreseeable future actions that affect water use and quality, including the other Federal and non-Federal projects listed in Table 9-6. The Perkins site hydrology, water use, and water quality are discussed in the ER (Duke 2009c) and in the response to an RAI (Duke 2010l).

The geographic area of interest for the Perkins site is considered to be the drainage basin of the Yadkin River upstream and downstream of the site because this is the resource that would be affected if the proposed project were located at the Perkins site. The Yadkin River drains part of north-central North Carolina before it becomes the Pee Dee River at the confluence with the Uwharrie River and crosses into South Carolina. The Pee Dee continues through eastern South Carolina before entering the Atlantic Ocean at Winyah Bay. For groundwater, the geographic area of interest is limited to the site because Duke has indicated no plans for use of groundwater to build and operate the plant (Duke 2009c).

The cooling- and service-water supply for a two-unit nuclear generating station located at the Perkins site would be the Yadkin River. Based on U.S. Geological Survey (USGS) streamflow (USGS 2011d) gage data the review team has independently estimated the average annual flow, the low monthly flow (30Q2 − the lowest average flow that occurs over 30 consecutive days and occurs once every 2 years on average), and the very low flow (7Q10 − the lowest average flow that occurs over 7 consecutive days that occurs once every 10 years, on average) conditions in the Yadkin River near the Perkins site to be 3000, 1153, and 630 cubic ft per second (cfs), respectively.

The Yadkin River has been identified by North Carolina as having an impaired use for fish consumption because of turbidity and mercury (NCDENR 2010c). The Pee Dee River has been identified by South Carolina as being impaired for fish consumption because of mercury, and impaired for aquatic life because of copper and lead (EPA 2010am).

Building Impacts

Because the building activities at the Perkins site would be similar to those at the Lee Nuclear Station site, the review team estimated the water needed for building activities at the Perkins site would be identical to the proposed water use for building at the Lee Nuclear Station site. Consistent with the Lee Nuclear Station, the review team assumed that groundwater would not be used. During building activities at the Lee Nuclear Station site, the average estimated water use is projected to be 250,000 gallons per day (gpd) or 0.39 cfs (see Table 3-5). This water-use rate is inconsequential when compared to the average annual flow in the Yadkin River (3000 cfs). The review team assumed that building activities could cease, if needed, during drought emergency without any significant overall impact on the schedule. Because the surface-water withdrawal would be minor compared to the average annual flow and because the withdrawal from the river would be temporary and limited to the building period, the review team concludes that the impact of surface-water use for building the potential units at the Perkins site would be minimal.

Duke stated that it would need to build three reservoirs at the Perkins site to support station operations. Duke's analysis of a worst-case drought based on the 2002 drought period indicates that a supplemental water supply would be required. During that drought period there were approximately 79 days when the Yadkin River flows dropped below 649 cfs, a river flow Duke estimated as the flow below which it would not be allowed to withdraw water from the river (Duke 2010l). The review team determined that the 2002 period of record represents the longest drought of record and that, of the 83 years in the historical record, only 15 years would require any withdrawal from the storage reservoir. Building the three reservoirs would alter the drainage of three tributary creeks to the Yadkin River to create the storage volume needed to supply supplemental condenser cooling water during future droughts of the magnitude experienced in 2002 (Duke 2010l). Based on the small number of creeks affected and their small drainage areas the changes to flow in the Yadkin as a result of building these reservoirs would not be detectable.

As stated above, the review team assumed that no groundwater would be used to build the units at the Perkins site. The review team also assumed that the impact of dewatering the excavations needed for building two units at the site would be temporary and minor at the Perkins site because technology (such as slurry walls, grouting) is readily available to control water inflow to the excavation if needed. Therefore, because there would be no groundwater use and the impact of dewatering would be temporary and minor, the review team determined that there would be minimal impact on groundwater resources.

Surface-water quality could be affected by stormwater runoff during site preparation and the building of the facilities. The North Carolina Division of Water Quality would require Duke to develop an SWPPP. The SWPPP would identify BMPs to control the impacts of stormwater runoff. The review team anticipates that Duke would construct new detention and infiltration ponds and drainage ditches to control delivery of sediment from the disturbed area to nearby waterbodies. Sediment carried with stormwater from the disturbed area would settle in the detention ponds and the stormwater would infiltrate into the shallow aquifer. As a result, stormwater runoff is not anticipated to affect water quality in the river. Therefore, during building activities, the surface-water-quality impacts near the Perkins site would be temporary and minimal.

While building new nuclear units at the Perkins site, impacts on groundwater quality may occur from leaching of spilled effluents into the subsurface. The review team assumes that the BMPs Duke has proposed for the Lee Nuclear Station site would also be in place during building activities at the Perkins site, and therefore the review team concludes that any spills would be quickly detected and remediated. As discussed in Section 4.2.3.1, the development of a SWPPP with its call for implementation of BMPs would minimize water-quality impacts. Because any spills related to building activities would be quickly remediated under BMPs, and the activities would be temporary, the review team concludes that the groundwater-quality impacts from building at the Perkins site would be minimal.

Operational Impacts

The review team assumed that the cooling-water system for the proposed plant, if built and operated at the Perkins site, would be similar to that proposed at the Lee Nuclear Station site; specifically, the cooling-water system would use cooling towers and blowdown would be discharged to the Yadkin River.

Duke proposes that three cooling-water reservoirs with a total capacity of 33,000 ac-ft would provide supplemental water during very low-flow conditions when adequate water from the river may not be available (Duke 2010l). Duke did not provide details of the cooling-water intake and effluent discharge locations. However, it is standard practice for power plants to design cooling-water intake and effluent discharge locations such that recirculation of discharged effluent to the intake does not occur.

Duke determined that the total amount of water withdrawn from the water source to operate two units would be approximately 35,000 gallons per minute (gpm) (78 cfs). About 2000 gpm (4.5 cfs) would be used for the screen wash system and thus return to the river at the intake location. As indicated for the Lee Nuclear Station site in Chapter 3, consumptive losses through evaporative losses and drift from cooling two units would be approximately 24,700 gpm (55 cfs) (Duke 2009c). The remaining 18 cfs would be returned via pipeline to the river at the discharge location. The water withdrawal and consumptive use represents 6.8 and 4.8 percent, respectively, of the Yadkin streamflow during low-flow conditions (30Q2) of 1153 cfs. Based on the small fraction of available water that would be used during low-flow conditions and the proposed use of a water-storage reservoir during very low-flow periods, the review team determined that the operational impact of the proposed plant at the Perkins alternative site on surface water would be minimal. Similar to the Lee Nuclear Station, the reservoir refill rate was assumed to be 200 cfs. This would be limited based on current in-stream flow conditions and would only be used after the reservoir had been drawn down to provide water for plant operation during drought periods.

As stated above, the review team assumed that no groundwater would be used to operate the units at the Perkins site. Therefore, because there would be no groundwater use, the review team determined that there would be no impact on groundwater resources.

During the operation of the proposed units at the Perkins site, impacts on surface-water quality could result from stormwater runoff, discharges of treated sanitary and other wastewater, and blowdown from cooling towers into the Yadkin River. The review team assumed that the blowdown rate would be the same as that at the Lee Nuclear Station site, 8216 gpm (18 cfs). Blowdown would be regulated by the North Carolina Department of Environment and Natural Resources (NCDENR) pursuant to 40 CFR Part 423 and all discharges would be required to comply with limits established by NCDENR in an NPDES permit.

The NCDENR would require Duke to develop an SWPPP. The plan would identify measures to be used to control stormwater runoff. Because stormwater controls would be in place and blowdown discharges would be regulated under an NPDES permit, the review team concludes that the impacts on surface-water quality from operation of two nuclear units at the Perkins site would be minimal.

During the operation of new nuclear units at the Perkins site, impacts on groundwater quality could result from potential spills. Spills that might affect the quality of groundwater would be prevented or remediated by using BMPs. Because BMPs would be used to quickly remediate spills and no intentional discharge to groundwater should occur, the review team concludes that the impacts on groundwater quality from operation of two nuclear units at the Perkins site would be minimal.

Cumulative Impacts

In addition to water-use and water-quality impacts from building and operations activities, cumulative impacts analysis considers other past, present, and reasonably foreseeable future actions that affect the same environmental resources.

For the cumulative analysis of impacts on surface water, the geographic area of interest for the Perkins site is the same as mentioned earlier in this section. Key actions that have past, present, and future potential impacts on surface-water supply and surface-water quality in this drainage basin include the operation of the W. Kerr Scott Reservoir upstream of the Perkins site and High Rock Lake, Tuckertown Reservoir, Badin Lake, and Falls Reservoir downstream of the site. These reservoirs and dams serve to increase the reliability of water supply to the region and to provide power. Lake Tillery and additional dams and reservoirs occur on the Pee Dee River downstream from the Perkins site.

The U.S Global Change Research Program (GCRP) has compiled the state of knowledge in climate change (GCRP 2009). This compilation has been considered in the preparation of this EIS. The projections for changes in temperature, precipitation, droughts, and increasing reliance on aquifers within the Yadkin River Basin are similar to those at other alternative sites in the region. These regional changes are discussed in Section 7.2 of this EIS.

Cumulative Water Use

Based on a review of the GCRP assessment of the Southeast United States region, the review team conservatively estimated a decrease in streamflow of 10 percent over the life of the station. By adjusting the historical flows for this climate change impact, the review team determined that the fraction of the withdrawal and consumptive water use for the revised low flow (30Q2) would increase from 6.8 to 7.5 percent and 4.8 to 5.3 percent, respectively. The review team also considered the increased water demands associated with an increased population in the region. The NCDENR indicates that water supplied for residential and non-residential use in the Yadkin-Pee Dee Basin will increase to 221 million gallons per day (Mgd) by 2020, an increase of 58 Mgd (90 cfs) over 1997 levels (NCDENR 2001).

By considering the impact of climate change on historical flows and allowing for continued increase in water demand due to population growth in the region, the review team determined that the reservoirs would be needed more frequently as time goes on and, in some instances, the plant would exhaust its water supply and the units might be required to derate or cease operation.

The impacts of the other projects listed in Table 9-6 are considered in the analysis above or would have little or no impact on surface-water use. The projects believed to have little impact are excluded from the analysis either because they are too distant from the Perkins site, use relatively little or no surface water, or have little or no discharge to surface water. Some projects (e.g., park and forest management) are ongoing, and changes in their operations that would have large impacts on surface-water use appear unlikely.

The review team determined that the cumulative impacts on water supply in the Yadkin River associated with operation of the proposed units, other water users, climate change, and population growth are MODERATE, but the incremental impact associated with water use for the Perkins site was determined not to be a significant contributor to the MODERATE impact.

As stated above, the review team assumed that no groundwater would be used to build or operate the units at the Perkins site and that groundwater impacts from dewatering would be temporary and minor. Therefore, the review team determined that the Perkins site by itself would have minimal impact on groundwater resources.

Other projects listed in Table 9-6 are, for the most part, 10 or more miles away from the Perkins site and thus will not contribute to a cumulative impact on groundwater supply within the ROI.

Because groundwater-use impacts are limited and temporary due to aquifer dewatering during the building phase, and other projects are not anticipated near the Perkins site, the review team concludes that cumulative impacts on groundwater use at the alternative site would be SMALL.

Cumulative Water Quality

Point and nonpoint sources have affected the water quality of the Yadkin River upstream and of the Yadkin and Pee Dee Rivers downstream of the site. Water-quality information presented above for the impacts of building and operating the proposed new units at the Perkins site would also apply to evaluation of cumulative impacts. The Yadkin River appears on North Carolina's list of impaired waters because of turbidity and the presence of mercury in fish tissue (NCDENR 2010c) and the Pee Dee River is listed on the South Carolina 303(d) list for mercury for fish consumption and copper and lead for aquatic life use (EPA 2010am). Therefore, the review team concludes that the cumulative impact on surface-water quality of the receiving waterbody would be MODERATE. As mentioned above, the State of North Carolina requires an applicant to develop a SWPPP. The plan would identify measures to be used to control stormwater runoff. The blowdown would be regulated by EPA pursuant to 40 CFR Part 423 and all discharges would be required to comply with limits established by NCDENR in a NPDES permit. Such permits are designed to protect water quality. Therefore, because industrial and wastewater discharges from the proposed units would comply with NPDES permit limitations and any stormwater runoff from the site during operations would comply with the SWPPP, the review team concludes that building and operating the proposed units at the Perkins site would not be a significant contributor to cumulative impacts on surface-water quality.

Other projects listed in Table 9-6 are, for the most part, 10 or more miles away from the Perkins site and thus will not contribute to a cumulative impact on groundwater quality in the ROI. The review team also concludes that with the implementation of BMPs, the impacts of groundwater quality from building and operating two new nuclear units at the Perkins site would likely be minimal. Therefore, the cumulative impact on groundwater quality would be SMALL.

9.3.3.3 Terrestrial and Wetland Resources

The following analysis includes impacts from building and operating the proposed new facilities on terrestrial ecology resources at the Perkins site. The analysis also considers past, present, and reasonably foreseeable future actions that affect the terrestrial ecological resources, including other Federal and non-Federal projects and the projects listed in Table 9-6. For the analysis of terrestrial ecological impacts at the Perkins site, the geographic area of interest includes the portions of Davie, Davidson, Forsyth, and Rowan Counties that are within a 15-mi radius of the Perkins site. This area encompasses the supplemental water reservoirs and all the ancillary facilities (two transmission lines, a cooling-water pipeline, and a railroad spur), and the important animal and plant species, communities, and wildlife aggregations that could be affected. The 15-mi distance was used by NCDENR for its species and habitat of concern occurrence analysis.

In developing this EIS, the review team relied upon reconnaissance-level information to perform the alternative site evaluation in accordance with ESRP 9.3 (NRC 2000a). Reconnaissance-level information is data that are readily available from agencies and other public sources such as scientific literature, books, and Internet websites. It also can include information obtained from site visits. To identify terrestrial resources at the Perkins site, the review team relied primarily on the following information:

- Perkins Nuclear Station ER (Duke Power Company 1974d) and Lee Nuclear Station COL ER and supplement (Duke 2009b, c)
- Lee Nuclear Station Joint Application for Activities Affecting Waters of the United States submitted by Duke (2011h) to the USACE
- a tour of the Perkins alternative site in April 2008 (NRC 2008d) and a tour of the Perkins site and reservoir sites in August 2010 (NRC 2010c)
- responses to RAIs provided by Duke (2010g)
- Endangered Species, Threatened Species, and Candidate Species in North Carolina (FWS 2010e) and North Carolina Natural Heritage Program (NCDENR 2012b) county record information
- correspondence regarding species and habitat occurrences from NCDENR (2012a).

Site Description

The Perkins site is situated within the Piedmont ecoregion in North Carolina (Griffith et al. 2002). As described in Section 7.3.1, the Piedmont ecoregion has been altered to a great extent since European settlement, primarily because of farming, agriculture, and silviculture. National Land Cover Data based on 2001 imagery (MRLC 2011) indicate that the Perkins site is a mixture of deciduous forest, evergreen forest, and pasture/herbaceous cover. Under an agreement with Duke, the Perkins site is managed as game land by the North Carolina Wildlife Resources Commission (NCWRC 2011a). As described in Section 9.3.3.1, operation of new facilities at the Perkins site would require three supplemental cooling-water reservoirs and ancillary facilities consisting of a railroad spur, two transmission lines, and a cooling-water pipeline.

The NRC staff visited the Perkins site in April 2008 and the Perkins site and the sites of the three associated cooling reservoirs in August 2010 (NRC 2008d, 2010c). The presumed power-block area consists mostly of open field vegetation, while the surrounding area consists mostly of approximately 30-year-old pine forest. The reservoir sites contain narrow riparian corridors consisting mostly of approximately 30-year-old bottomland hardwood forest with pastures and old-field areas located immediately upslope. In addition, pine plantations and a few single family residences may be affected by reservoir development. The reservoir sites are characteristic of small stream environments in the Piedmont ecoregion.

Federally Listed and State-Ranked Species, Communities, and Wildlife Aggregations

Duke provided no new field survey information for the Perkins site beyond its characterization in the early 1970s for the Perkins Nuclear Station (Duke Power Company 1974d). The review team is unaware of any field surveys at the locations of the three cooling-water reservoirs or the ancillary facilities. The presence/absence of Federally listed and State-ranked species, communities, and wildlife aggregations in the project footprint cannot be ascertained without field surveys.

A query of the North Carolina Natural Heritage Program database (NCDENR 2012a) indicates the presence of 35 species, communities, and wildlife assemblages within 15 mi of the Perkins site in Davie, Davidson, Forsyth, and Rowan Counties that are either Federally listed as threatened, endangered, or candidates for listing, and/or are ranked by the State of North Carolina as critically imperiled, imperiled, or vulnerable (Table 9-8). Table 9-8 lists species habitat affinities. The State ranking (in addition to the Federal listing) provides the only common basis for comparison of numbers of important animal and plant species, communities, and wildlife aggregations among the proposed and alternative sites located in North Carolina and South Carolina. Some of the State-ranked animal and plant species have also been assigned a State protection status as threatened, endangered, of concern, or significantly rare (Table 9-8).

Of the 35 species, communities, and wildlife aggregations documented in Table 9-8, 2 are listed as Federally endangered and one is a candidate for listing. Michaux's sumac (*Rhus michauxii*) is considered endangered and is currently known from Davie County. Schweinitz's sunflower (*Helianthus schweinitzii*) is considered endangered and is currently known from Davidson and Rowan counties. Georgia aster (*Symphyotrichum georgianum*) is a candidate species and is currently known in Davidson and Rowan counties (FWS 2010e). These three species occur in open areas such as utility corridors (FNA 1993+; Gleason and Cronquist 1991). Bald eagles (*Haliaeetus leucocephalus*) are currently protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d) and are known to occur in Davidson and Rowan counties.

Two North Carolina State rare plant species—spring coral-root (*Corallorhiza wisteriana*) and ringed witch grass (*Dichanthelium annulum*)—have been documented within or adjacent to the project footprint. Spring coral-root has been documented within the Perkins site and in the vicinity of the cooling-water pipeline (Duke 2010g). The species has a sporadic distribution, and either has not been found in recent surveys within Davie County; or has not been surveyed recently enough to be confident that it is still present; or the occurrence is thought to be destroyed (NCDENR 2012b). Ringed witch grass has been documented within the vicinity of the Perkins site and supplemental water reservoirs (Duke 2010g). The species is on the periphery of its range in North Carolina, and either has not been found in recent surveys within Davie or Rowan Counties; or has not been surveyed recently enough to be confident that it is still present; or the occurrence is thought to be destroyed (NCDENR 2012b).

Table 9-8. Terrestrial Federally Listed Species and Candidate Species, and State-Ranked Species, Communities, and Wildlife Aggregations within 15 mi of the Perkins Site in Davie, Davidson, Forsyth, and Rowan Counties, North Carolina

Scientific Name	Common Name	Federal Status[(a)]	NC State Rank/ Protection Status[(b)]	Counties of Occurrence[(c)]	Habitat[(d)]
Mammals					
Myotisleibii	eastern small-footed bat	-	S3/SC	Davidson (current)	hilly or mountainous areas, in or near deciduous or evergreen forest
Birds					
Haliaeetus leucocephalus	bald eagle	BGEPA	S3B-S3N/T	Davidson (current), Rowan (current)	major rivers, large lakes, reservoirs[(e)]
Lanius ludovicianus	loggerhead shrike	-	S3B-S3N/SC	Davie (current), Davidson (current), Forsyth (current)	open country with scattered trees and shrubs
Amphibians					
Ambystoma talpoideum	mole salamander	-	S2/SC	Davidson (current), Rowan (current)	near breeding ponds in pine flatwoods, floodplains, and bottomland hardwood forests
Plants					
Amorpha schwerinii	Piedmont indigo-bush	-	S3/SR-T	Davidson (current), Rowan (current)	xeric and rocky forests and woodlands
Brachythecium rotaeanum	Rota's feather moss	-	S1/SR-D	Rowan (historical)	rotted logs, tree bases, wet forests[(f)]
Corallorhiza wisteriana	spring coral-root	-	S1S2/SR-O	Davie (historical)	moist forests

Table 9-8. (contd)

Scientific Name	Common Name	Federal Status[a]	NC State Rank/ Protection Status[b]	Counties of Occurrence[c]	Habitat[d]
Cirsium carolinianum	Carolina thistle	-	S2/E	Rowan (current)	prairies, open woodlands
Dichanthelium annulum	ringed witch grass	-	S1/SR-P	Davie (historical), Rowan (historical)	dry sandy or rocky soil of open woods, dry grasslands, barrens, and glades
Helianthus schweinitzii	Schweinitz's sunflower	E	S3/E	Davidson (current), Rowan (current)	woodlands and roadsides, xeric oak-pine woodlands, mowed road or powerline corridors
Hexalectris spicata	crested coralroot	-	S2/SR-P	Davidson (historical), Davie (historical)	dry forests and woodlands
Isoetes piedmontana	Piedmont quillwort	-	S2/E	Rowan (historical)	seepage on granitic flatrocks
Isoetes virginica	Virginia quillwort	-	S1/SR-L	Rowan (historical)	in woodland streams
Lotus helleri (=*Acmispon helleri*)	Carolina birdfoot-trefoil	-	S3/SC-V	Davidson (current), Rowan (current), Davie (historical)	dry woodlands and openings, originally probably prairie-like sites, now along roadbanks, railroads, powerline corridors
Matelea decipiens	glade milkvine	-	S3/SR-P	Davidson (historical)	woodlands and thickets
Minuartia uniflora	single-flowered sandwort	-	S1/E	Rowan (historical)	granitic flatrocks

Table 9-8. (contd)

Scientific Name	Common Name	Federal Status[(a)]	NC State Rank/ Protection Status[(b)]	Counties of Occurrence[(c)]	Habitat[(d)]
Portulaca smallii	Small's portulaca	-	S2/T	Forsyth (current), Rowan (current)	granitic and diabase flatrocks, sometimes spreading to adjacent fields, mowed areas, or other disturbed areas
Rhus michauxii	Michaux's sumac	E	S2/E	Davie (current)	sandy or rocky open woods, usually on ridges with a disturbance history (periodic fire, prior agricultural use, maintained right-of-ways)[(g)]
Ruellia purshiana	Pursh's wild-petunia	-	S2/SC-V	Davidson (current), Forsyth (historical)	dry woodlands and forests
Silphium terebinthinaceum	prairie dock	-	S2/SR-P	Davie (current)	glades, barrens, woodlands, and roadsides
Symphyotrichum georgianum	Georgia aster	C	S3/T	Davidson (current), Rowan (current)	dry, rocky woodlands; woodland borders; roadbanks; and powerline corridors
Tortula papillosa	papillose tortula	-	S1/SR-P	Davie (historical)	grows on mature trees[(h)]
Communities					
basic mesic forest (Piedmont subtype)	-	-	S3S4	Davidson (current), Davie (current), Forsyth (current), Rowan (current)	-

Table 9-8. (contd)

Scientific Name	Common Name	Federal Status[(a)]	NC State Rank/ Protection Status[(b)]	Counties of Occurrence[(c)]	Habitat[(d)]
dry basic oak-hickory forest	-	-	S2S3	Davidson (current), Rowan (current)	-
dry-mesic basic oak-hickory forest (Piedmont subtype)			S3	Davie (current), Davidson (current), Rowan (current)	
floodplain pool	-	-	S2	Davie (current), Rowan (current)	-
low-elevation seep (floodplain subtype)	-	-	S2	Davidson (current), Forsyth (current)	-
mesic mixed hardwood forest (Piedmont subtype)			S3S4	Davidson (current), Davie (current), Forsyth (current), Rowan (current)	
mixed moisture hardpan forest			S2	Davie (current)	
Piedmont bottomland forest (high subtype)	-	-	S2	Davie (current),	-
Piedmont bottomland forest (typic low subtype)			S2	Davidson (current), Davie (current)	
Piedmont levee forest (typic subtype)	-	-	S3S4	Davidson (current), Forsyth (current), Rowan (current)	-
Piedmont swamp forest	-	-	S2	Rowan (current)	-

Table 9-8. (contd)

Scientific Name	Common Name	Federal Status[(a)]	NC State Rank/ Protection Status[(b)]	Counties of Occurrence[(c)]	Habitat[(d)]
upland depression swamp forest	-	-	S2S3	Davidson (current), Rowan (current)	-
Wildlife Aggregations					
colonial wading bird colony	-	-	S3	Davidson (current), Forsyth (current), Rowan (current)	-

Source: Federal Status, NC State Rank/Protection Status (NCDENR 2012a)
Source: Counties of Occurrence (NCDENR 2012b)
Source: Habitat (as noted)
(a) Federal status: E = endangered, C = candidate, BGEPA = species not protected under the Endangered Species Act of 1973, as amended, but protected under Bald and Golden Eagle Protection Act (FWS 2010e).
(b) State rank: S1 = critically imperiled, S2 = imperiled, S3 = vulnerable, S4 = apparently secure, S#S# = a numeric range rank used to indicate uncertainty about the exact status of the element, B = breeding, N = non-breeding. State status: E = endangered, T = threatened, SC = special concern, SC-V = special concern/vulnerable, SR-D = significantly rare/disjunct (disjunct to North Carolina from its main range), SR-L = significantly rare/limited (only found in North Carolina and adjacent states, with a majority of populations in North Carolina), SR-O = significantly rare/range is sporadic (other), SR-P = significantly rare/species at the periphery of its range, SR-T = significantly rare/throughout its range (fewer than 100 populations total) (NCDENR 2012b).
(c) current = There is at least one record for the element in the region that has been seen recently. historical = either the element has not been found in recent surveys in the region; or it has not been surveyed recently enough to be confident they are still present; or the occurrence is thought to be destroyed (NCDENR 2012b).
(d) NatureServe Explorer (2010) for animals and Weakley (2010) for plants, unless otherwise indicated.
(e) 64 FR 36454.
(f) NatureServe Explorer (2010).
(g) FWS (2012c).
(h) British Bryological Society (2010).

Building Impacts

Building activities for two nuclear units would remove about 288 ac of high-quality wooded habitat (Duke 2010g) and disturb about 0.5 ac of wetlands (Duke 2010g, 2011h). Site preparation for the railroad spur, two transmission lines, and cooling-water pipeline would remove approximately 140 ac of high-quality wooded habitat (Duke 2010g) and disturb about 24 ac of wetlands (Duke 2010g, 2011h). Site preparation and inundation of the three supplemental cooling reservoirs would impact about 1000 ac of high-quality wooded habitat (Duke 2010g)and about 92 ac of wetlands (Duke 2010g, 2011h). Site preparation at the Perkins site and the ancillary facilities, and site preparation and inundation of the three cooling reservoirs, would affect 222,000 linear ft (approximately 42 mi) of streams (Duke 2010g, 2011h). The riparian corridors of about 187,000 linear ft (approximately 35 mi) of these streams would be permanently inundated by creation of the three reservoirs. It is uncertain to what extent riparian corridors would be affected along the other 35,000 linear ft (approximately 7 mi) of streams associated with the Perkins site and ancillary facilities, because it would depend on the need to clear riparian vegetation (e.g., for transmission-line clearance), and the length of stream that would be so affected has not been determined (Duke 2011h). The overall impact of reservoir development on terrestrial resources at the three supplemental cooling-reservoir sites would be noticeable and permanent.

Two State-ranked rare plant species could be affected by development of the Perkins site and associated facilities (Duke 2010g). Other important species that may be present in the project footprint (Table 9-8) could also be affected. Impacts on wildlife at the Perkins site would be noticeable, similar to those described for the proposed Lee Nuclear Station site in Section 4.3.1.

Operational Impacts

Impacts on terrestrial ecological resources from operation of two new nuclear units at the Perkins site would be minor and similar to those for the proposed Lee Nuclear Station site as described in Section 5.3.1. There may be minor differences in operational impacts because of factors such as climate, topography, and elevation.

Cumulative Impacts

Overlaying the historic impacts in the Piedmont ecoregion discussed in the Site Description above are the current projects listed in Table 9-6. Projects located within the geographic area of interest include Boone’s Cave State Park, Tanglewood Park, the Winston-Salem Northern Beltway, Buck Combined Cycle Station, Plant Rowan, and two manufacturing facilities (one glass and the other plastic). The development of most of these projects has further reduced, fragmented, and degraded natural forests and wetland habitat and decreased habitat connectivity. In contrast, the parks protect local terrestrial resources in perpetuity. Reasonably foreseeable projects and land uses within the geographic area of interest that would affect terrestrial resources include ongoing silviculture, farming, and agricultural development, and residential and possibly some limited commercial development.

Summary

Impacts on terrestrial ecology resources are estimated based on the information provided by Duke and the review team's independent review. Site preparation and inundation of the three cooling-water reservoirs, and site preparation and development of the Perkins site, two new transmission-line corridors, a water-pipeline corridor, and a railroad spur would affect a total of about 1428 ac of high-quality forest habitat, about 117 ac of wetlands, and about 42 mi of riparian corridor. The overall impact of these activities on habitat and wildlife would be noticeable and permanent, particularly in the watersheds containing the three reservoirs. There are 22 Federally listed or State-ranked terrestrial species, 12 communities, and 1 wildlife aggregation that potentially occur at the Perkins site and associated facilities that may be affected. There are past, present, and future activities in the geographic area of interest that have affected and would continue to significantly affect habitat and wildlife in ways similar to site preparation and development for the above facilities (i.e., silviculture, farming, and agricultural development, and residential and possibly some limited commercial development).

The review team concludes that the cumulative impacts from past, present, and reasonably foreseeable future actions, including two new nuclear units at the Perkins site and associated facilities, on baseline conditions for terrestrial ecological resources in the geographic area of interest would be MODERATE. The incremental contribution to these impacts from building and operating two new nuclear units at the Perkins site would be significant. The impact could be greater if Federally listed species are present.

9.3.3.4 Aquatic Resources

The following analysis includes impacts from building and operating the proposed new facilities on aquatic ecology resources at the Perkins site. The analysis also considers past, present, and reasonably foreseeable future actions that affect the aquatic ecological resources, including other Federal and non-Federal projects and the projects listed in Table 9-6. For the analysis of aquatic ecological impacts at the Perkins site, the geographic area of interest includes the Yadkin River Headwaters Watershed to the upper end of High Rock Lake at the confluence of the Yadkin River and the South Yadkin River, including the tributaries that would be impounded to create three supplemental water reservoirs, and waterbodies crossed by the ancillary facilities (two transmission-line corridors, a cooling-water pipeline, and a railroad-spur corridor). This geographic region is considered the most likely to show impacts on water quality relative to the water-quality criteria for aquatic biota.

In developing this EIS, the review team relied upon reconnaissance-level information to perform the alternative site evaluation in accordance with ESRP 9.3 (NRC 2000a). Reconnaissance-level information is data that are readily available from agencies and other public sources such as scientific literature, books, and Internet websites. It also can include information obtained through site visits. To identify aquatic resources at the Perkins site, the review team relied primarily on the following information:

- Perkins Nuclear Station ER (Duke Power Company 1974d) and Lee Nuclear Station COL ER and supplement (Duke 2009b, c)
- Lee Nuclear Station Joint Application for Activities Affecting Waters of the United States submitted by Duke (2011h) to the USACE
- a tour of the Perkins alternative site in April 2008 (NRC 2008d) and a tour of the Perkins alternative site and supplemental cooling-water reservoir sites in August 2010 (NRC 2010c)
- responses to RAIs provided by Duke (2010g, 2010l)
- Endangered Species, Threatened Species, and Candidate Species in North Carolina (FWS 2010e) and North Carolina Natural Heritage Program county record searches (NCDENR 2012b)
- correspondence regarding species occurrence from the NCDENR (NCDENR 2012a).

Site Description

The Perkins site is a greenfield site located on the Yadkin River in Davie County, North Carolina. The site is owned by Duke and managed by the NCWRC. The Yadkin River, which borders the south side of the alternative reactor site, is the largest and most important aquatic resource near the Perkins site.

The staff visited the Perkins site in April 2008 and August 2010 (NRC 2008d, 2010c). The Yadkin River near the proposed cooling-water intake site had steep vegetated banks covered with riparian vegetation. The streams that would be converted to cooling-water reservoirs contain narrow riparian corridors. The cooling-water reservoir sites are characteristic of small stream environments in the Piedmont ecoregion.

Recreationally Important Species

Some fish commonly caught in the Yadkin River near the Perkins site include Largemouth Bass (*Micropterus salmoides*), Smallmouth Bass (*M. dolomieu*), Spotted Bass (*M. punctatus*), sunfish (*Lepomis* spp.), catfish (*Ameiurus, Ictalurus,* and *Pylodictis* spp.), Striped Bass (*Morone saxatilis*), and White Bass (*M. chrysops*). These fish are common to this region of the state.

Non-Native and Nuisance Species

Spotted Bass are not native to North Carolina but have been illegally introduced by anglers because they are a popular sport fish. They may competitively displace Smallmouth and Largemouth Bass (NCWRC 2010). Spotted Bass also are correlated with declines in crappie fisheries (*Pomoxis* spp.) in some areas.

Federally Listed and State-Ranked Species

Duke provided no new field survey information for the Perkins site beyond its characterization in the early 1970s for the Perkins Nuclear Station (Duke Power Company 1974d). The review team is unaware of any field surveys performed at the sites of the proposed three cooling-water reservoirs, the two transmission-line corridors, water-pipeline corridor, or railroad-spur corridor. The presence/absence of Federally listed and State-ranked species in the project footprint cannot be ascertained without field surveys.

A recent review of the Federally listed and State-ranked aquatic species that may occur in Davie, Davidson, Forsyth, and Rowan Counties in North Carolina near the Perkins site was performed by the review team. No Federally listed aquatic species were identified. State-ranked species included five fish, one crayfish, seven mussels, and five insects, as shown in Table 9-9. The State ranking (in addition to the Federal listing) provides the only common basis for comparison of numbers of important aquatic species among the proposed and alternative sites located in North Carolina and South Carolina. The 18 State-ranked species include the Quillback (*Carpoides cyprinus*), Carolina Darter (*Etheostoma collis*), Roanoke Hog Sucker (*Hypentelium roanokense*), Bigeye Jumprock (*Moxostoma ariommum*) and Robust Redhorse (*M. robustum*); the Greensboro burrowing crayfish (*Cambarus catagius*); the brook floater *(Alasmidonta varicosa),* yellow lampmussel (*Lampsilis cariosa*), eastern lampmussel (*L. radiata*), creeper (*Strophitus undulatus*), notched rainbow (*Villosa constricta*), eastern creekshell (*V. delumbis*), and Carolina creekshell (*V. vaughaniana*); the Cherokee clubtail dragonfly (*Gomphus consanguis*), Cahaba sand-filtering mayfly (*Homoeoneuria cahabensis*) and three other insects with aquatic life stages (a caddisfly [*Dibusa angata*], a mayfly [*Macdunnoa brunnea*], and the mountain river cruiser mayfly [*Macromia margarita*]). In addition, the Robust Redhorse, brook floater, yellow lampmussel, and Carolina creekshell are assigned a State protection status of endangered and the Bigeye Jumprock, eastern lampmussel, and creeper are assigned a State protection status of threatened. Of the species listed in Table 9-9, the Quillback, yellow lampmussel, eastern lampmussel, Cahaba sand-filtering mayfly, and the *Dibusa* caddisfly have been positively identified by the State as occurring within 15 mi of the Perkins site (NCDENR 2012a). The State-ranked species are listed in Table 9-9 along with their counties of occurrence, but only the State-listed (i.e., protected) species are discussed in further detail.

Table 9-9. Aquatic Federally Listed Species and State-Ranked Species in Davie, Davidson, Forsyth, and Rowan Counties, North Carolina

Scientific Name	Common Name	Federal Status[a]	NC State Rank/ Protection Status[b]	Counties of Occurrence[c]
Fish				
Carpoides cyprinus	Quillback	-	S2?/SR	Davidson (current) Davie (current) Forsyth (current)
Etheostoma collis	Carolina Darter	-	S3/SC	Davidson (current))
Hypentelium roanokense	Roanoke Hog Sucker		S3/SR	Forsyth (current)
Moxostoma ariommum	Bigeye Jumprock	-	S1/T	Forsyth (current)
Moxostoma robustum	Robust Redhorse	-	S1/E	Davidson (historical) Davie (historical)
Crayfish				
Cambarus catagius	Greensboro burrowing crayfish	-	S2/SC	Davidson (current)
Mussels				
Alasmidonta varicosa	Brook floater	-	S1/E	Forsyth (current)
Lampsilis cariosa	Yellow lampmussel	-	S1/E	Davie (current) Rowan (current)
Lampsilis radiata	Eastern lampmussel	-	S1S2/T	Davidson (current) Rowan (current)
Strophitus undulatus	Creeper	-	S2/T	Davidson (obscure) Forsyth (current)
Villosa constricta	Notched rainbow	-	S3/SC	Davidson (current) Rowan (current)
Villosa delumbis	Eastern creekshell	-	S3/SR	Davidson (current)
Villosa vaughaniana	Carolina creekshell	-	S2/E	Rowan (current)
Insects (with aquatic lifestage)				
Dibusa angata	A caddisfly	-	S2/SR	Davie (current) Rowan (current)
Gomphus consanguis	Cherokee clubtail dragonfly	-	S1?/SR	Davie (obscure)
Homoeoneuria cahabensis	Cahaba sand-filtering mayfly	-	S2/SR	Rowan (current)
Macdunnoa brunnea	A mayfly	-	S2/SR	Davie (current)
Macromia margarita	Mountain river cruiser mayfly		S1S2/SR	Davie (current)

(a) Federal status: (FWS 2010e).
(b) State rank: S1 = critically imperiled, S2 = imperiled, S3 = vulnerable, ? = uncertain (inexact or uncertain numeric rank used as a qualifier), S#S# = a numeric range rank used to indicate uncertainty about the exact status of the element; State protection status: E = endangered, T = threatened, SC = special concern, SR = significantly rare (NCDENR 2012b).
(c) current = There is at least one record for the element in the region that has been seen recently. historical = Either the element has not been found in recent surveys in the region, or it has not been surveyed recently enough to be confident they are still present; or the occurrence is thought to be destroyed. obscure = The date the element was last observed in the region is uncertain (NCDENR 2012b).

Bigeye Jumprock

The Bigeye Jumprock is a sucker species that inhabits the Upper and Middle Roanoke River drainage in North Carolina. This basin touches the northeast corner of Forsyth County, but the fish has not been recorded from the Pee Dee River Basin. It is unlikely that the Bigeye Jumprock is present in the Yadkin River near the proposed Perkins site. Therefore, it is not likely to be directly affected by the building or operation of two new nuclear units at the Perkins site.

Robust Redhorse

In North Carolina, Robust Redhorse are found in the Pee Dee River downstream of Blewett Falls Dam (NCWRC 2007). Habitat loss resulting from the impoundment of North Carolina rivers and streams has precipitated a decline in the species' numbers and range. In the Pee Dee River, spawning takes place in large, rocky shoals (NCWRC 2007). Other factors in the Robust Redhorse's decline is the deterioration of water quality because of sedimentation and pollution, as well as predation and competition for resources by non-native species such as the Flathead Catfish (*Pylodictis olivaris*), Blue Catfish (*Ictalurus furcatus*), and Smallmouth Buffalo (*Ictiobus bubalis*) (NCWRC 2007). Because Robust Redhorse are blocked from further upstream migration by Blewett Falls Dam, this species is not likely to be directly affected by the building or operation of a nuclear facility at the Perkins site.

Brook Floater

In North Carolina, the brook floater is found in the Pee Dee River Basin. It has been seen recently in Forsyth County, upstream from the proposed Perkins site (NCWRC 2008b). It prefers clean, swift waters with stable gravel or sand and gravel substrates, although it has infrequently been found in sandy/silty substrate in shallow water with little current. The Yadkin River near the Perkins site may be too turbid to support a brook floater population; however, because recent surveys have not been conducted specifically looking for the species in the vicinity of the Perkins site, it is possible that one or more could be present and could potentially be affected by station construction and/or operation.

Yellow Lampmussel

In North Carolina, the yellow lampmussel has been found in the Pee Dee, Waccamaw, Cape Fear, Neuse, and Tar River Basins. Within the Pee Dee River Basin it has been reported in Montgomery County (Little River Basin) (NCWRC 2008b). The yellow lampmussel can be found in many different habitats; however, it appears to slightly prefer the shifting sands downstream from large boulders in relatively fast flowing, medium-sized rivers and medium-to-large-sized creeks (NCWRC 2008b). It is unlikely that the yellow lampmussel is present in the

Yadkin River near the proposed Perkins site. Therefore, it is not likely to be directly affected by the building or operation of two new nuclear units at the Perkins site.

Eastern Lampmussel

The range of the eastern lampmussel includes the PeeDee, Waccamaw, Cape Fear, Neuse, and Pamlico Basins, and in particular the Lower Yadkin River (NatureServe Explorer 2010). The eastern lampmussel is considered to be doing well throughout its range with a stable or increasing population. It is highly tolerant of environmental conditions and uses common fish species as hosts. It finds a wide variety of habitats suitable, including small streams, large rivers, ponds and lakes, although it prefers a sand or gravel bottom. It has been observed within 15 mi of the proposed site, though downstream of the proposed site in a tributary to the Yadkin River. Therefore, it is not likely to be directly affected by the building or operation of two new nuclear units at the Perkins site.

Creeper

The creeper is found in the Atlantic slope and Interior Basin drainages of North Carolina, including the Broad, Pee Dee, Cape Fear, Neuse, Pamlico, and Roanoke River Basins (Bogan 2002). The species is found in a variety of aquatic habitats, but nearly always in shallow water of depths no more than 3 or 4 ft. It is sometimes found in lakes, but appears unable to reproduce in lake habitat (SCDNR 2005). It is generally restricted to streams with very good water quality so it may be more sensitive to sedimentation and pollution than many other mussel species. The species is listed as threatened in North Carolina because it appears to be declining throughout its range. A 2007 mussel survey of the Upper Yadkin River (above the proposed Perkins site) discovered seven individuals (Jones et al. 2007).

Carolina Creekshell

The range of the Carolina creekshell includes the Yadkin-Pee Dee River Basin, but downstream from the Perkins site and outside the geographic area of interest (NCWRC 2011b). While typically found in silty sand or clay along the banks of small streams, the Carolina creekshell also may inhabit substrates of mixed sand and gravel. Because it is unlikely to be located near the proposed Perkins site, it is not likely to be directly affected by building or operating two new nuclear units at the Perkins site.

Critical Habitats

No critical habitat has been designated by the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS) in the vicinity of the Perkins site.

Building Impacts

Building impacts would likely include impacts on water quality from direct (e.g., dredging, shoreline excavation, clearing, impoundment) and indirect (e.g., stormwater runoff, sedimentation) sources. Two new reactor units at the site would require cooling-water intake and effluent discharge systems. Water would be withdrawn from the Yadkin River (Duke 2009c). Blowdown would also be discharged to the Yadkin River downstream from the intake. Operation of new facilities at the Perkins site would require three new supplemental cooling-water reservoirs (totaling 1500 ac [Duke 2010g] with approximately 33,000 ac-ft of storage [Duke 2010l]), and ancillary facilities consisting of a railroad spur, two transmission lines, and a cooling-water pipeline (Duke 2010g). Two new transmission lines would be required to connect the site to the existing transmission-line corridors, as discussed in Section 9.3.3.1. Site preparation and development impacts on aquatic resources from the transmission lines would be similar to those described for the proposed Lee Nuclear Station site in Section 4.3.2. The new reactor site, reservoirs, and ancillary facilities would impact an estimated 222,000 linear ft (approximately 42 mi) of creek systems, which includes the conversion of 187,000 linear ft of stream from lotic to lentic ecosystems for the supplemental cooling-water reservoirs (Duke 2010g). Building activities would also affect a total of 2.6 ac of open water (2.4 ac associated with reservoirs and 0.2 ac associated with ancillary features) (Duke 2011h). The impacts of building two new nuclear units and three new reservoirs on the aquatic ecology of the Yadkin River and its tributaries would be clearly noticeable and permanent.

Operational Impacts

Because a closed-cycle cooling system and supplemental cooling-water reservoirs are proposed for the Perkins site, operational impacts would be expected to be similar to those for the proposed Lee Nuclear Station site as described in Section 5.3.2.

Cumulative Impacts

Current actions in the vicinity that have present and future potential impacts on aquatic ecological resources include discharge of water by domestic and industrial NPDES permit holders, withdrawal of water for domestic and industrial purposes, the existence of nature preserves, and future urbanization of the area (Table 9-6).

Within the Yadkin River Headwaters Watershed, there are currently at least one major and two minor NPDES discharge permit holders, including wastewater-treatment plants (NCDENR 2008a). Just downstream from the Headwaters Watershed and just upstream of High Rock Lake, Duke operates the Buck Combined Cycle Station. The station’s cooling towers use ambient air for steam condenser cooling, which minimizes intake and discharge impacts on the Yadkin River. No heated water is discharged to the Yadkin River (Duke Energy 2013c). Tanglewood Park and Boone’s Cave Park preserve some of the Yadkin River shoreline upstream and downstream from the Perkins site, respectively, thereby limiting the potential for future urbanization in those areas. Reasonably foreseeable projects and water uses within the geographic area of interest that would affect aquatic resources include farming, and agricultural development, and residential and possibly some limited commercial development.

Summary

Impacts on aquatic ecology resources are estimated based on the information provided by Duke and the review team's independent review. The most noticeable building activities would affect about 222,000 linear ft (approximately 42 mi) of stream habitat and the associated aquatic species (Duke 2010g). The impacts of building two new nuclear units and three new reservoirs on the aquatic ecology of the Yadkin River and tributaries would be clearly noticeable.

There are 18 State-ranked aquatic species that potentially occur near the Perkins site and associated facilities that may be affected. Five of these species have been positively identified as occurring within 15 mi of the Perkins site (NCDENR 2012a). Surveys to determine the presence or absence of other Federally listed and State-ranked species have not been performed in the recent past.

The review team concludes that the cumulative impacts from past, present, and reasonably foreseeable future actions, including two new nuclear units at the Perkins site and associated facilities, on baseline conditions for aquatic ecological resources in the geographic area of interest would be MODERATE. The incremental contribution to these impacts from building and operating two new nuclear units at the Perkins site would be significant. The impact would be greater if surveys reveal that Federally listed species are present.

9.3.3.5 Socioeconomics

For the analysis of socioeconomic impacts at the Perkins site, the geographic area of interest is considered to be the 50-mi region centered on the Perkins site with special consideration of the two-county area of Davie and Forsyth Counties, where the review team expects socioeconomic impacts to be the greatest. In evaluating the socioeconomic impacts of building and operations at the Perkins site, the review team undertook a reconnaissance survey of the region using readily obtainable data from the ER; the alternative site audit; and Federal, State, and local government agencies. The cumulative impacts analysis also considers other past, present, and reasonably foreseeable future actions that affect the same environmental resources, including other Federal and non-Federal projects and the projects listed in Table 9-6.

Socioeconomic impacts span the issues of physical impacts, demography, economic conditions and taxes, and infrastructure and community services. The impacts of building and operating the new units are discussed below.

Physical Impacts

Many physical impacts of building and operation would be similar regardless of the site. Building activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, shock from blasting, and dust emissions. The use of public roadways, railways, and waterways would be necessary to transport materials and equipment. Offsite areas that would support building activities (e.g., borrow pits, quarries, and disposal sites) would be expected to be already permitted and operational. Offsite activities would include the development of three supplemental reservoirs, a railroad spur, new transmission-line corridors, and a cooling-water pipeline (Duke 2010g). Part of the area proposed for the supplemental reservoirs has been moderately developed with housing, which would have to be removed.

Potential impacts from station operation include noise, odors, exhausts, thermal emissions, and aesthetics. New units would produce noise from the operation of pumps, cooling towers, transformers, turbines, generators, and switchyard equipment. In addition, traffic at the site would be a source of noise. The review team assumed that same standard noise protection and abatement procedures used for the Lee Nuclear Station site would be used to control noise at the Perkins site. Commuter traffic would be controlled by speed limits. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to the Perkins site.

The new units at the Perkins site would likely have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that resultant air emissions comply with applicable regulations. In addition, the generators would be operated on a limited, short-term basis. During normal plant operation, new units would not use a significant quantity of chemicals that could generate odors that exceed odor detection threshold values. Good access roads and appropriate speed limits would minimize the dust generated by the commuting workforce.

Areas used for forests and timber production would be altered by development of the two new transmission-line corridors (Duke 2009c). The Perkins site is a greenfield site, but the surrounding area is undergoing a moderate amount of residential development, particularly where the supplemental reservoirs would be constructed (Duke 2009b, c). The review team concludes that the impacts of building two units, three supplemental water reservoirs, and ancillary facilities at the Perkins site on aesthetics would be noticeable, but that the impacts for operations would be minimal.

Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that the physical impacts of building and operating two new nuclear units at the Perkins site would be minimal except for a noticeable physical impact on aesthetics during the building phase.

Demography

The Perkins site is located in Davie County, North Carolina, with a population of 40,581 near the towns of Mocksville (population 4952) and Bermuda Run (population 1667), which are located to the west and north of the site, respectively (USCB 2010e). Also within the 50-mi region are the Cities of Lexington (population 19,155), which is in Davidson County (population 160,638); Winston-Salem (population 224,769), which is located in Forsyth County (population 342,989); and Greensboro (population 263,358) which is located in Guilford County (USCB 2010e).

Based on the proposed site location, the regional population distribution, and U.S. Census Bureau Journey to Work Data (USCB 2000h), the review team expects the in-migrating population would reside in the two-county area of Davie and Forsyth Counties. The review team realizes that workers may choose to live in other counties within the 50-mi region, but given the small number of workers and the large population base the review team expects impacts on other counties to be *de minimis.* Therefore, these two counties compose the economic impact area and are the focus of the following analysis.

At the peak of the nuclear power station development, Duke expects the workforce onsite to be approximately 4613 workers. Because the Perkins site is similar to the proposed Lee Nuclear Station site in geography and urbanization, development of the proposed new units on the Perkins site would have similar socioeconomic impacts in most respects to building the two units on the Lee Nuclear Station site. Based on the analysis of project impacts presented in Section 4.4.2, of the 4613 peak workers approximately 3191 workers would migrate into the region with some workers bringing a family for a total in-migrating population of 4516 people. Considering that the maximum estimation of in-migrating population is less than 1 percent of the existing regional population, the review team expects the demographic impacts of building two units on the Perkins site would be minimal. Once the plant is operational, Duke estimates the workforce to be about 957 workers with an estimated 345 migrating into the region, similar to the Lee Nuclear Station site. Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that the demographic impacts of building and operating two new nuclear units at the Perkins site would be minimal.

Economic Impacts on the Community

<u>Economy</u>

The local workforce is dominated by government, manufacturing, retail trade, and educational services. Agriculture represents 45 percent (76,295 ac) of total Davie County land area (Duke 2009c). Davie County's 2009 labor force was 20,778 with an unemployment rate of 11.4 percent. Forsyth County's 2009 labor force was 172,845 with an unemployment rate of 9.7 percent. The 2006 unemployment rates for Davie and Forsyth Counties were 4.2 percent and 4.3, respectively (BLS 2011a). The significant increase in unemployment rates between 2006 and 2009 is attributed to the recent economic downturn afflicting much of the country.

The wages and salaries of the project workforce would have a multiplier effect that would result in increases in business activity, particularly in the retail and service sectors. This multiplier effect would have a positive impact on the business community and could provide opportunities for new businesses and increased employment opportunities for local residents. The review team expects most indirect jobs created in the region would be allocated to residents in the region. Expenditures made by the indirect workforce would also strengthen the regional economy. Because the review team assumes the economic impacts of the Lee Nuclear Station site (in Sections 4.4.3.1 and 5.4.3.1) also apply to the Perkins site, the review team concludes the impact of these new indirect jobs would constitute a small percentage of the total number of jobs in Davie and Forsyth Counties and would have a minimal and beneficial economic impact.

Taxes

If the proposed nuclear station was located at the Perkins site, Duke would pay property taxes according to North Carolina law. The amount of property taxes paid is unknown because it relies on several parameters such as the assessed value, millage rates, and annual depreciation. Duke owns the McGuire Nuclear Station in Mecklenburg County, North Carolina and paid $8.8 million in property taxes in 2008. If Duke pays a similar amount of taxes at the Perkins site as it does for the McGuire Nuclear Station, the impact on taxes would be substantial given the relatively small tax base of Davie County, but minimal throughout the remainder of the 50-mi region.

Infrastructure and Community Services

Traffic

Davie County is served by several U.S. highways. Mocksville is an important center for highway transportation because US-158, US-64, and US-601 all meet there. These three highways join I-40 approximately 9 mi northwest of the Perkins site and I-85 is located approximately 9 mi southeast of the site. The Perkins site is accessible from State Route 801 (NC 801), which connects to US-601 and US-64 (Duke 2009c). The development of a nuclear facility on the Perkins site would require road modifications (e.g., road widening and site access roads). A railroad spur would need to be built for the transport of materials and equipment to the site, and there is residential area near the site (Duke 2009c). Given the large number of additional vehicles added to the roads during peak construction, the review team expects traffic-related impacts from building the plant at the Perkins site would be noticeable but not destabilizing on roads near the site. The review team expects traffic-related impacts from operations of a nuclear power station on the Perkins site to be minimal due to the smaller workforce needed.

Housing

Based on the analysis in Section 4.4.2, approximately 3191 workers would migrate into the region during the peak employment period of the building phase. Later, approximately

345 operations workers would migrate into the region by the time the plant becomes operational. The 2006–2010 American Community Survey (ACS) estimate for Davie County indicated a total housing stock of 17,923 units, of which 2091 were vacant (USCB 2010e). Forsyth County had 154,153 housing units of which approximately 17,541 were vacant (USCB 2010e). The review team expects that the in-migrating construction workforce could be absorbed fairly easily into the existing housing stock in the region and the impact would be minimal.

Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that traffic-related and housing impacts of building two new nuclear units at the Perkins site would be minor across the region with the exception of noticeable, but not destabilizing, traffic-related impacts on roads closest to the site. Because of the much lower number of operations-related workers relative to workers during the building phase, the review team determined traffic-related and housing impacts from operations would be minimal.

Recreation

No recreational facilities exist within the site boundary; however, the Perkins State Game Lands are within the boundaries of one of the reservoirs. Recreational activities near the Perkins site include golf, camping, and other outdoor activities (Davie County Chamber of Commerce 2013). Boone's Cave State Park, Perkins State Game Preserve, and Alcoa State Game Lands are all located within 5 mi of the Perkins site. Similar to each alternative site and the proposed site, the supplemental reservoirs would not be available for public recreation. Duke has not indicated that recreational activities near the Perkins site would be limited during building or operation of a nuclear project. However access to the Perkins State Game Lands may be restricted for the life of the project. Other recreational areas are far enough offsite not to be affected. Therefore, the review expects impacts on recreation would be minimal for both building and operating two new nuclear units at the Perkins site.

Public Services

The influx of construction workers and plant operations staff settling in the region could affect local municipal water and water-treatment facilities, police, fire, medical, and other social services in the area. Davie County has two water suppliers and one wastewater-treatment plant. The impact on public services would depend on the infrastructure that is developed on the site as well as the location in which the in-migrating workforce chooses to live. The in-migrating workers represent a small portion of the total populations of Davie and Forsyth Counties and the review team expects they would have a minimal impact on public services.

Education

Davie County has 12 schools: six elementary schools, three middle schools, and three high schools. The kindergarten through 12th grade enrollment for the 2010-2011 school year was

6786 students (NCES 2013). Forsyth County has 90 schools in the county's district with a 2010-2011 kindergarten through 12th grade student enrollment of 55,232 and 6 special needs schools and academies with an additional enrollment of 1975. The review team expects, based upon the same underlying assumptions that governed the analysis for the proposed Lee Nuclear Station site, that approximately 400 students would move into the two-county area during the peak employment period for building activities. Assuming equal distribution of those students between counties, 200 additional students in each school district would represent a less than 5 percent increase in the student body population. Therefore, the review team determined building a nuclear facility on the Perkins site would have a minimal impact on education, and that the much smaller operations workforce would also have a minimal impact on education. Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that public services and education impacts of building and operating two new nuclear units at the Perkins site would be minimal.

Summary of Building and Operation Impacts

Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Social and economic impacts span issues of demographics, economy, taxes, infrastructure, and community services. In summary, based on information provided by Duke and the review team's independent evaluation, the review team concludes that the adverse impacts on socioeconomics of building and operating a new nuclear plant at the Perkins site would be minor for most of the region but could be noticeable, but not destabilizing, for Davie County in terms of traffic-related impacts during peak project employment. During operations, traffic-related impacts are expected to be minimal. Impacts on aesthetics would be noticeable. The impacts on the Davie County tax base during operations likely would be substantial and beneficial; however only minimal beneficial tax impacts would result in the rest of the region.

Cumulative Impacts

The projects identified in Table 9-6, particularly the future urbanization of the region, have contributed or would contribute to the demographics, economic climate, and community infrastructure of the region and generally result in increased urbanization and industrialization. Because the projects within the review area identified in Table 9-6 would be consistent with applicable land-use plans and control policies, the review team considers the cumulative socioeconomic impacts from the projects to be minimal.

For the analysis of socioeconomic impacts at the Perkins site, the geographic area of interest is considered to be the 50-mi region centered on the Perkins site, with special consideration of Davie and Forsyth Counties, where the review team expects socioeconomic impacts to be the greatest.

The Perkins site is located in southeastern Davie County on the Davie and Davidson County border. The employment in the area near the Perkins site is a mixture of government, manufacturing, retail trade, and educational services. The nearest towns are Mocksville (population 4952) and Bermuda Run (population 1667) (USCB 2010ee), which are located to the west and the north of the site, respectively. The large metropolitan area of Winston-Salem is located northeast of the Perkins site.

The cumulative impact analysis considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative socioeconomic impacts on a given region, including other Federal and non-Federal projects and the projects listed in Table 9-6. Adverse cumulative impacts would include physical impacts (on workers and the local public, buildings, roads, and aesthetics), demographic impacts, and impacts on local infrastructures and community services (transportation; recreation; housing; water and wastewater facilities; police, fire, and medical services; social services; and education).

Because most projects described in Table 9-6 do not include any significant reasonably foreseeable changes in socioeconomic impacts within 50 mi of the Perkins site, the review team determined there would be no significant additional cumulative socioeconomic impacts in the region from those activities. Regional planning efforts and associated demographic projections available at a reconnaissance level formed the basis for the review team's assessment of reasonably foreseeable future impacts. Any economic impacts associated with activities listed in Table 9-6 would have been considered as part of the socioeconomic baseline.

The review team concludes that building two nuclear units at the Perkins site, in addition to other past, present, and reasonably foreseeable future projects would have cumulative economic impacts on the community that would be beneficial and SMALL with the exception of Davie County, which would see a LARGE and beneficial cumulative impact on taxes. The cumulative infrastructure and community services impacts would be SMALL with the exception of a MODERATE and adverse cumulative impact on traffic near the Perkins site. The cumulative physical impacts would be SMALL with the exception of a MODERATE and adverse impact on aesthetics near the site. The cumulative impacts of demography would be SMALL. Building and operating the proposed units at the Perkins site would be a significant contributor to the LARGE and beneficial economic impact on taxes in Davie County and also to the MODERATE and adverse impact on infrastructure and community services related to traffic near the site and the MODERATE physical impact on aesthetics.

9.3.3.6 Environmental Justice

The 2006–2010 ACS5-year population estimates at the census block groups level were used to identify minority and low-income populations in the region, and used the same sources and methodology explained in Section 2.6.1 for the proposed site, including a closer look at potential areas of interest using a series of health and physical considerations. There were 1840 census block groups within the 50-mi region (USCB 2011c). Approximately 490 of these census block groups were classified as having aggregate minority populations of interest and 366 were classified as African American populations of interest. The review team also identified 17 census block groups that had an Asian, 1 block group with a Native Hawaiian or Pacific Islander, 54 with “other” race, and 118 with Hispanic populations of interest. Davie County did not have any census block groups with minority populations of interest. There were 190 census block groups classified as having low-income populations of interest in the 50-mi region, none of which were in Davie County. Nearby Forsyth County had 49 census block groups with African American, 8 with “other” race, 143 with aggregate minority, and 23 with Hispanic populations of interest. There were 41 census block groups with low-income populations of interest. The nearest census block groups with minority and low-income populations of interest were located in Davidson and Rowan Counties. The review team did not identify any Native American communities or other minority communities with the potential for a disproportionately high and adverse impact due to their unique characteristics or practices. Figure 9-3 shows the geographic locations of the minority populations of interest within the 50-mi radius of the Perkins site, and Figure 9-4 shows the geographic locations of the low-income populations of interest within the 50-mi radius of the Perkins site.

Physical impacts from building activities (e.g., noise, fugitive dust, air emissions, traffic) attenuate rapidly with distance, topography, and intervening vegetation. Therefore, the review team determined that, given the distance from the Perkins site to the nearest populations of interest, there would be no physical impacts with a disproportionately high and adverse effect on minority or low-income populations. For the same reasons, the review team determined the operation of the proposed project at the Perkins site is also unlikely to have a disproportionately high and adverse impact on minority or low-income populations. Supplemental water reservoirs near the site would be needed, which would require acquiring private property from current residents and demolishing houses. New transmission-line corridors would be constructed to link the proposed units to the electric grid. Given the distance between the Perkins site and the location of minority and low-income populations of interest, impacts from the supplemental water reservoirs and transmission-line corridors would not disproportionately and adversely affect minority or low-income populations. See Sections 2.6, 4.5, and 5.5 for more information about environmental justice criteria and impacts.

In addition to environmental justice impacts from building and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to disproportionately high and adverse impacts on minority and low-income populations, including other Federal and non-Federal projects and the projects listed in Table 9-6. For the analysis of environmental justice impacts at the Perkins site, the geographic area of interest is considered to be the 50-mi region centered on the Perkins site.

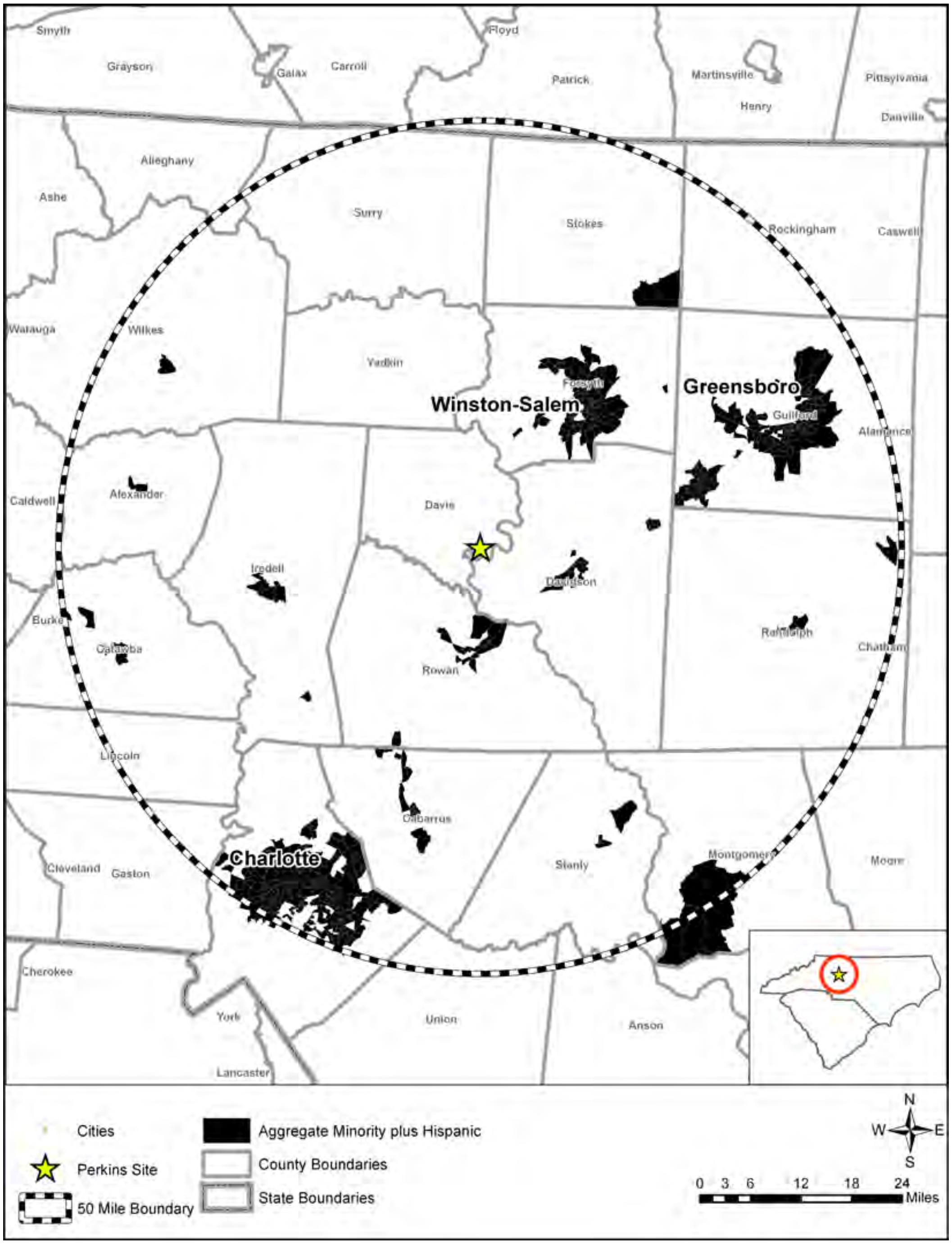

Figure 9-3. Aggregate Minority Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Perkins Site (USCB 2011c)

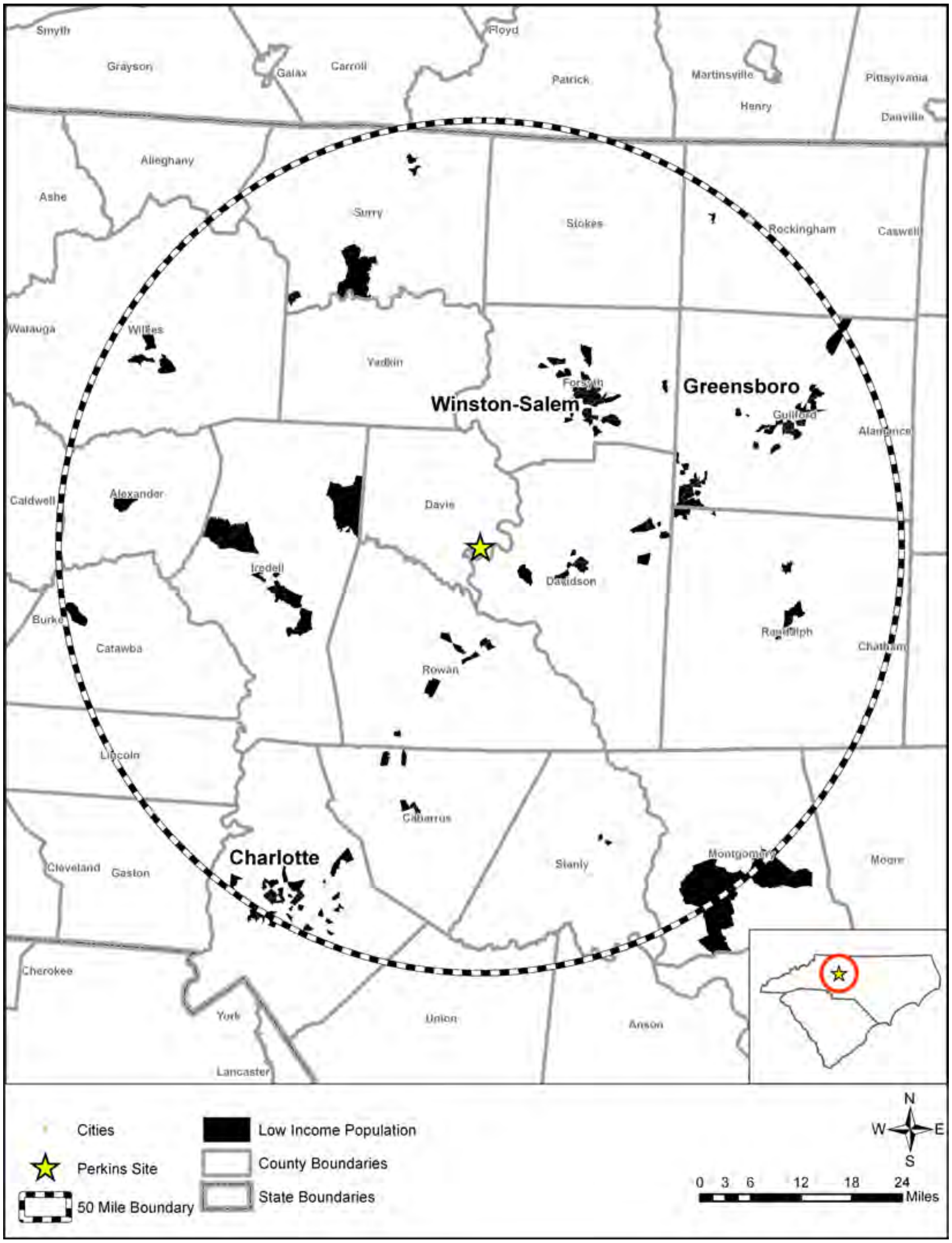

Figure 9-4. Low-Income Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Perkins Site (USCB 2011c)

The projects identified in Table 9-6 likely did not or would not contribute to environmental justice impacts of the region. Therefore, based on information provided by Duke and the review team's independent evaluation, the review team concludes there would not be any disproportionately high and adverse environmental justice cumulative impacts from the building and operation of two nuclear units at the Perkins site in addition to other past, present, and reasonably foreseeable future projects, and the cumulative environmental justice impacts would be SMALL.

9.3.3.7 Historic and Cultural Resources

The following analysis addresses impacts on historic and cultural resources from building and operating two new nuclear generating units at the Perkins site in Davie County, North Carolina. The analysis also considers other past, present, and reasonably foreseeable future actions that could cause cumulative impacts on cultural resources, including other Federal and non-Federal projects as listed in Table 9-6. For the analysis of cultural resources impacts at the Perkins site, the geographic area of interest is considered to be the onsite and offsite direct physical and indirect visual areas of potential effect (APEs) associated with the proposed undertaking. This includes direct physical APEs, defined as the onsite areas directly affected by site development and operation activities as well as offsite areas such as railroad corridors, transmission lines, and new reservoirs. Indirect visual APEs are also included and defined generally as a 1-mi radius buffer around the proposed direct physical APEs, which encompasses the approximate maximum distance from which tall structures could be seen.

Reconnaissance activities in a cultural resources review have particular meaning. Typically such activities include preliminary field investigations to confirm the presence or absence of historic properties or cultural resources. However, in developing this EIS, the review team relied upon reconnaissance-level information to perform the alternative sites evaluation in accordance with ESRP 9.3 (NRC 2000a). Reconnaissance-level information in this context is data that are readily available from agencies and other public sources. It can also include information obtained through site visits. To identify historic and cultural resources at the Perkins site, the review team relied on the following information:

- the Perkins Nuclear Station ER (Duke Power Company 1974d) and Lee Nuclear Station COL ER (Duke 2009c)
- an August 2010 tour of the Perkins site and visit to the Martin-Wall History Room at the Davie County Public Library, Mocksville, North Carolina (NRC 2010c)
- archival records searches and National Register listings provided by Duke (Duke 2010t)
- the National Park Service's listing of properties on the National Register of Historic Places (National Register) (NPS 2011b).

Site Description

Historically, the Perkins site and vicinity were largely undisturbed and contained intact archaeological resources associated with the past 10,000 years of human settlement. Cotton cultivation also occurred historically in some areas. Several cultural resources investigations were conducted at the site and vicinity in the 1970s during preparations for the Perkins Nuclear Station (Duke Power Company 1974d, Duke 2010t) and more than 80 archaeological sites were identified.

Duke completed a records search at the North Carolina Office of the State Archaeologist to assemble a list of previously recorded cultural resources and historic properties listed or eligible for listing on the National Register that could be affected if the Perkins site was selected for nuclear plant development (Duke 2010t). According to the search results, at least six prehistoric archaeological sites and one historic cemetery are located within the direct physical APE for the proposed plant site. At least four prehistoric archaeological sites and one National Register-eligible historic architectural property may be directly affected by proposed offsite reservoirs. Visual impacts in the indirect visual APEs within 1 mi of the direct APEs could affect 5 historic cemeteries, 4 National Register-listed historic properties, 8 properties and 2 historic districts evaluated as potentially eligible for nomination to the National Register, and at least 64 unassessed historic architectural resources. Records searches were not completed for the proposed new offsite railroad line or transmission lines.

Most of the archaeological sites previously recorded in the direct physical APEs at the Perkins site and in the direct physical APEs for proposed offsite reservoirs were evaluated in the 1970s (using approved methodologies of the time) and found not eligible for nomination to the National Register (Duke Power Company 1974d). It is also likely that the majority of historic architectural resources located in the indirect visual APEs for the plant and reservoirs are ineligible for nomination. However, direct physical impacts would be unavoidable at one historic cemetery, protected by State law, in the direct, physical APE and one National Register-eligible property located in the direct physical APE of a proposed reservoir. Indirect visual impacts associated with proposed new reservoirs would also be unavoidable at four National Register-listed properties as well as eight properties and two historic districts potentially eligible for National Register listing.

Building and Operation Impacts

In the event that the Perkins site was chosen for the proposed project, the review team assumes that Duke would employ the same methods for identifying and assessing impacts on historic properties and cultural resources as those used during assessments at the Lee Nuclear Station site and associated developments. This would include field investigations and coordination with the North Carolina State Historic Preservation Office (SHPO), interested American Indian Tribes, and the public, which would be conducted before the initiation of any ground-disturbing activities. The results of these investigations and consultations would be used in the site planning process to avoid or mitigate impacts and develop protective measures for any significant resources, such as those already listed on the National Register. Duke has committed to this approach for the Lee Nuclear Station site and the review team assumes that Duke would employ the same methods at alternative sites, if chosen for the proposed project (Duke 2009j). Initial archival searches indicate that appropriate mitigations would need to be developed for at least 1 historic cemetery in the direct physical APE for the Perkins site; 1 National Register-eligible historic property in the direct physical APE of an offsite reservoir; and for at least 12 National Register-listed or eligible properties in indirect visual APEs for the proposed reservoirs. Additional important historic and cultural resources may also be discovered during new surveys in all APEs. As a result, impacts on cultural resources due to site development and building activities could be noticeable, but not destabilizing with appropriate mitigations implemented.

Impacts on historic and cultural resources from operation of the two new nuclear units at the Perkins site as well as parallel and related operations at offsite components such as the new reservoirs, railroad line, and transmission-line corridors would be possible. The review team assumes that Duke Energy's corporate policy for consideration of cultural resources and associated procedures in the event of an unanticipated discovery of cultural resources would apply to operations at the Perkins site and offsite areas (Duke 2009j). Further, the review team assumes that Duke would negotiate an agreement and associated cultural resources management plan for the Perkins site with the North Carolina SHPO, the USACE, and interested American Indian Tribes similar to efforts completed for the Lee Nuclear Station site (USACE et al. 2013). Under consistent application of Duke Energy's corporate policy for cultural resources and an agreement and cultural resources management plan specific to the Perkins site, impacts on historic and cultural resources due to operations would be negligible.

Cumulative Impacts

The geographic area of interest for cumulative impacts on historic and cultural resources at the Perkins site corresponds to the onsite and offsite direct (physical) and indirect (visual) APEs defined for the site. Past actions in the geographic area of interest that have affected historic and cultural resources in a manner similar to those associated with the building and operation of the two new units and other project components include limited residential development and attendant transportation and utility development, and it is reasonable to assume that these developments will continue. This future urbanization of the area identified in Table 9-6 may affect historic and cultural resources in the geographic area of interest. No other activities identified in Table 9-6 are located in the geographic area of interest and none would contribute to cumulative impacts on historic and cultural resources in a manner similar to the impacts associated with the building and operation of the two new nuclear units.

Summary

Cultural resources are non-renewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that the cumulative impacts from building and operating two new nuclear units on the Perkins site and from future urbanization of the area would be MODERATE. The incremental contribution of building and operating the two new units and associated plant components would be significant to these cumulative impacts given the historic properties and cultural resources known to exist within the onsite and offsite direct and indirect APEs and the geographic area of interest.

9.3.3.8 Air Quality

The following impact analysis includes impacts on air quality from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that affect air quality, including other Federal and non-Federal projects listed in Table 9-6. The air-quality impacts related to building and operating a nuclear facility at the Perkins site would be similar to those at the Lee Nuclear Station site.

The Perkins site is located in Davie County, North Carolina, which is part of the Northern Piedmont Intrastate Air Quality Control Region (40 CFR 81.150). The geographic area of interest for this resource area is the 50-mi radius of the Perkins site, which includes Davie County. Designations of attainment or nonattainment are made on a county-by-county basis. Davie County is designated as unclassifiable or in attainment for all criteria pollutants for which National Ambient Air Quality Standards (NAAQS) have been established (40 CFR 81.334). Criteria pollutants include ozone, PM, CO, No_x, SO_2, and lead. Davie County came into attainment with the 8-hour ozone standard on April 15, 2008, and is, therefore, considered a maintenance area for ozone (40 CFR 81.334). An applicability analysis would need to be performed per 40 CFR Part 93 Subpart B to determine if a general conformity determination is needed. The closest Class 1 Federal Area (i.e., Linville Gorge Wilderness Area) is more than 50 mi from the Perkins site and it would, therefore, not likely be affected by minor source emissions from the site. Class I areas are considered of special national or regional natural, scenic, recreational, or historic value and are afforded additional air quality protection.

As described in Section 4.7, emissions of criteria pollutants from building the two units are expected to be temporary and limited in magnitude. As discussed in Section 5.7, emissions criteria pollutants from operations would be primarily from the intermittent use of standby diesel generators and pumps. Given the temporary air emissions from construction and intermittent air emissions from operation, and that Davie County is currently designated as being unclassified or in attainment for criteria pollutants, the review team concludes the impacts from building and operating two new nuclear units on criteria pollutants would be minimal.

Cumulative impacts on air quality resources are estimated based on the information provided by Duke and the review team's independent evaluation. There are no projects listed in Table 9-6 that are major sources of NAAQS criteria pollutants within Davie County. Other past, present, and reasonably foreseeable activities exist in the geographic area of interest that could affect air quality resources. The impacts on criteria pollutants in Davie County from emissions of effluents from the Perkins site and other projects and activities within the 50-mi region would not be noticeable.

The greenhouse gas emissions from two nuclear units at the Perkins site would be the same as those analyzed in Chapters 4, 5, and 6 for the Lee Nuclear Station site. The cumulative impacts of greenhouse gas emissions related to nuclear power are discussed in Section 7.6. The impacts of the emissions are not sensitive to location of the source. Consequently, the conclusion in Section 7.6—national and worldwide impacts of greenhouse gas emissions are noticeable but not destabilizing—is applicable to two AP1000 reactors located at the Perkins site.

The review team concludes that the cumulative impacts, including those from other past, present, and reasonably foreseeable future actions on air quality resources in the geographic area of interest would be SMALL for criteria pollutants and MODERATE for greenhouse gas emissions. The incremental contribution of impacts on air quality resources from building and operating two units at the Perkins site would not be significant to the MODERATE air-quality impact from greenhouse gas emissions.

9.3.3.9 Nonradiological Health Impacts

The following analysis considers nonradiological health impacts from building and operating two new nuclear units at the Perkins site. Nonradiological health impacts at the Perkins site are estimated based on information provided by Duke and the review team's independent evaluation. The analysis also includes past, present, and reasonably foreseeable future actions that could contribute to cumulative nonradiological health impacts onsite workers and the public, including other Federal and non-Federal projects and the projects listed in Table 9-6. For the analysis of nonradiological health impacts at the Perkins site, the geographic area of interest is the immediate vicinity of the Perkins site and the associated transmission-line corridors. This area of interest is based on the localized nature of nonradiological health impacts.

Building activities with the potential to affect the health of members of the public and construction workers at the Perkins site include exposure to dust, vehicle exhaust, and emissions from construction equipment; noise; occupational injuries; and the transport of construction materials and personnel to and from the site. The operations-related activities that may affect the health of members of the public and workers include exposure to etiological (disease-causing) agents, noise, electromagnetic fields (EMFs), occupational injuries, and impacts from the transport of workers to and from the site.

Building Impacts

Nonradiological health impacts on construction workers and members of the public from building two new nuclear units at the Perkins site would be similar to those evaluated in Section 4.8 for the proposed Lee Nuclear Station site. Duke would comply with applicable Federal and State regulations on air quality and noise during the site preparation and building phase. The frequency of construction worker accidents would not be expected to be different from the frequency of accidents estimated for the Lee Nuclear Station site (discussed in Section 4.8).

Section 4.8.3 concludes that impacts on nonradiological health from the transport of construction workers and materials to and from the Lee Nuclear Station site would be minimal. Transportation impacts would be 24 percent lower for the Perkins site than for the Lee Nuclear Station site. This decrease is due to the difference in the average State-specific fatality rates used for construction workers in North Carolina and South Carolina. Nonradiological health impacts from transportation at the Perkins site would be minimal.

The Perkins site is located in a rural area and nonradiological health impacts from building would likely be negligible on the surrounding populations, which are classified as medium- and low-population areas. The review team concludes that nonradiological health impacts on construction workers and the public from building two new nuclear units, associated transmission lines, and three supplemental cooling-water reservoirs at the Perkins site would be minimal.

Operational Impacts

Nonradiological health impacts from operation of two new nuclear units on members of the public and workers at the Perkins site would be similar to those evaluated in Section 5.8 for the proposed Lee Nuclear Station site. Occupational health impacts on workers (e.g., falls, electric shock, or exposure to other hazards) at the Perkins site would likely be the same as those evaluated for workers at the proposed Lee Nuclear Station site. Exposure to the public from waterborne etiological agents at the Perkins site would be similar to the types of exposures evaluated in Section 5.8.1 for the Lee Nuclear Station site. The operation of new nuclear units at the Perkins site would not likely lead to an increase in waterborne diseases in the vicinity, due to the thermal mixing promoted by the discharge pipe and diffuser at the proposed plant, and temperature limitations prescribed by the plant NPDES permit on thermal discharge. Noise and EMF exposure would be monitored and controlled in accordance with applicable Occupational Safety and Health Administration (OSHA) regulations. Effects of EMF on human health would be controlled and minimized by conformance with National Electrical Safety Code (NESC) criteria.

Transportation of operations workers to and from the Perkins site would result in about a 2 percent increase in traffic fatalities in Davie County. This difference is solely because of differences in the average State-specific fatality rates used for operations workers and the county-specific baseline annual fatalities. Because these increases are small relative to the baseline traffic fatalities (i.e., before the new units are constructed), the review team concludes that the impacts of transporting construction materials and personnel to and from the Perkins site would be minimal. The review team concludes that nonradiological health impacts onsite workers and the public from the operation of the two nuclear units at the Perkins site would be minimal.

Cumulative Impacts

There are no past or current actions within the geographic area of interest that would have similar nonradiological health impacts as building and operating two nuclear units at the Perkins site. Proposed future actions that could cumulatively contribute to nonradiological health impacts at the Perkins site include the future development or upgrade of transmission lines and future urbanization throughout the immediate vicinity of the site.

The review team is also aware of the potential climate changes that could affect human health—a recent compilation of the state of knowledge in this area (GCRP 2009) has been considered in the preparation of this EIS. Projected changes in the climate for the southeastern region during the life of the proposed nuclear station include a small increase in average temperature; a decrease in precipitation in winter, spring, and summer; and a small increase in precipitation in fall (GCRP 2009). This may result in a small, gradual increase in river water temperature, which may alter the presence of microorganisms and parasites in the Yadkin River. While the changes attributed to climate change in these studies (GCRP 2009) may not be insignificant on a national or global level, the review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change the incidence of waterborne diseases in the vicinity of the Perkins site. The review team concludes that the cumulative impacts on nonradiological health from building two new nuclear units, associated transmission lines, and offsite reservoirs at the Perkins site would be minimal.

Summary

Nonradiological health impacts from building and operating two new units at the Perkins site are estimated based in the information provided by Duke and the review team's independent evaluation. The review team concludes that nonradiological health impacts on members of the public and construction workers from building two new nuclear units, associated transmission lines, and offsite reservoirs at the Perkins site would be minimal. The review team also expects that the occupational health impacts on members of the public and operations workers from two new nuclear units at the Perkins site would be minimal. Finally, the review team concludes that cumulative nonradiological health impacts from related past, present, and future foreseeable actions in the geographic area of interest would be SMALL. As discussed in Section 5.8, the NRC staff has not come to a conclusion on the chronic impacts of EMFs.

9.3.3.10 Radiological Health Impacts of Normal Operations

The following impact analysis includes radiological impacts on the public and workers from building activities and operations for two nuclear units at the Perkins alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health, including other Federal and non-Federal projects and the projects listed in Table 9-6. As described in Section 9.3.3, the Perkins site is a greenfield site; there are currently no nuclear facilities on the site. The geographic area of interest is the area within a 50-mi radius of the Perkins site. The only facility potentially affecting radiological health within this geographic area of interest is the existing McGuire Nuclear Station. In addition, medical, industrial, and research facilities that use radioactive material are likely to be within 50 mi of the Perkins site.

The radiological impacts of building and operating the proposed two AP1000 units at the Perkins site include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways would result in low doses to people and biota offsite that would be well below regulatory limits. The impacts are expected to be similar to those at the Lee Nuclear Station site.

The radiological impacts of McGuire Nuclear Station Units 1 and 2 include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways result in low doses to people and biota offsite that are well below regulatory limits as demonstrated by the ongoing radiological environmental monitoring program conducted around McGuire Nuclear Station. The NRC staff concludes that the dose from direct radiation and effluents from medical, industrial, and research facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the Perkins site. This conclusion is based on data from the radiological environmental monitoring programs conducted around currently operating nuclear power plants. Based on the information provided by Duke and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed AP1000 units and other existing and planned projects and actions in the geographic area of interest around the Perkins site would be SMALL.

9.3.3.11 Postulated Accidents

The following impact analysis includes radiological impacts from postulated accidents from the operation of two nuclear units at the Perkins alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health from postulated accidents, including other Federal and non-Federal projects and the projects listed in Table 9-6. As described in Section 9.3.3, the Perkins site is a greenfield site; there are currently no nuclear facilities at the site. The geographic area of interest considers all existing and proposed nuclear power plants that have the potential to increase theprobability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Perkins alternative site. Facilities potentially affecting radiological accident risk within this geographic area of interest are the existing H.B. Robinson Unit 2, Catawba Units 1 and 2, McGuire Units 1 and 2, and Harris Unit 1. In addition, two units (Units 2 and 3) have been proposed for the Harris site.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of design basis accidents (DBAs) at the Lee Nuclear Station site would be minimal for AP1000 reactors. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The AP1000 design is independent of site conditions, and the meteorology of the Perkins alternative and Lee Nuclear Station sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the Perkins alternative site would be minimal.

Assuming the meteorology, population distribution, and land use for the Perkins alternative site are similar to the proposed Lee Nuclear Station site, risks from a severe accident for an AP1000 reactor located at the Perkins alternative site are expected to be similar to those analyzed for the proposed Lee Nuclear Station site. The risks for the proposed Lee Nuclear Station site are presented in Tables 5-14 and 5-15 and are well below the median value for current-generation reactors. In addition, as discussed in Section 5.11.2, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For existing plants within the geographic area of interest (H.B. Robinson Unit 2, Catawba Units 1 and 2, McGuire Units 1 and 2, and Harris Unit 1), the Commission has determined that the probability-weighted consequences of severe accidents are small (10 CFR Part 51, Appendix B, Table B-1). Finally, according to the ER for Harris (PEC 2009), the risks from proposed Units 2 and 3 would also be well below risks for current-generation reactors and would meet the Commission's safety goals. On this basis, the NRC staff concludes that the cumulative risks from severe accidents at any location within 50 mi of the Perkins alternative site would be SMALL.

9.3.4 The Keowee Site

This section covers the staff's evaluation of the potential environmental impacts of siting two new nuclear reactors at the Keowee site located in Oconee County, South Carolina. The Keowee alternative site is adjacent to the existing Oconee Nuclear Station, and would share many of the same resources and services due to its proximity. The following sections describe a cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if it were implemented at the Keowee site, and other actions in the same geographic area were considered. This assessment includes the impacts of NRC-authorized construction, operations, and preconstruction activities. Also included in the assessment are other past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the Keowee site. Other actions and projects considered in this cumulative analysis are described in Table 9-10.

Table 9-10. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Keowee Alternative Site Cumulative Analysis

Project Name	Summary of Project	Location	Status
Nuclear Projects			
Oconee Nuclear Station Units 1, 2, and 3	Nuclear power generating plant with three units (846 MW(e) each)	Adjacent to the Keowee site	Oconee's three units are currently operational and are licensed through February 6, 2033, October 6, 2033, and July 19, 2034 (NRC 2012a)
Virgil C. Summer Nuclear Station (VCSNS) Unit 1	Nuclear power generating plant with one unit (966 MW(e))	Approximately 95 mi east-southeast of the Keowee site	VCSNS Unit 1 is currently operational and is licensed through August 6, 2042 (NRC 2012a)
VCSNS Units 2 and 3	Nuclear power generating plant with two Westinghouse AP1000 pressurized water reactors	Approximately 95 mi east-southeast of the Keowee site	Proposed operation would begin in 2016 and 2019 (NRC 2011f). COLs issued March 30, 2012 (NRC 2012a).
Vogtle Electric Generating Plant (VEGP)	Nuclear power generating plant with two units, VEGP 1 (1109 MW(e)) and VEGP 2 (1127 MW(e))	Approximately 130 mi southeast of the Keowee site	VEGP's two units are currently operational and are licensed through January 16, 2047 and February 9, 2049 (NRC 2012a)
VEGP Units 3 and 4	Nuclear power generating plant with two 1117-MW(e) Westinghouse AP1000 pressurized water reactors	Approximately 130 mi southeast of the Keowee site	Combined licenses and limited work authorizations issued February 10, 2012 (NRC 2012a, 2012k). Proposed operation would begin in 2016 for Unit 3 and 2017 for Unit 4.

Table 9-10. (contd)

Project Name	Summary of Project	Location	Status
Nuclear Fuel Services, Inc. Erwin Plant	Prepares highly enriched uranium and fabricates fuel for use in the DOE Naval Reactor Program. Also recovers highly enriched uranium from scrap, and blends high-enriched uranium with natural uranium to produce low-enriched uranium.	Erwin, Tennessee, approximately 96 mi north-northeast	Operational. License SNM-124 renewed August 2, 2012. Licensed through August 31, 2037 (NRC 2012j).
Other Energy Facilities			
John Rainey Generating Station	A 1095-MW, six-unit natural gas-fired peaking facility	Approximately 30 mi south of Keowee site	Operational (EPA 2010an; Santee Cooper 2013)
Lee Steam Station	A three-unit, 370-MW coal-fired power plant operated by Duke Energy	Approximately 29 mi east-southeast of the Keowee site	Operational (Duke Energy 2010p)
Hartwell Energy Facility	A two-unit, 360-MW natural-gas-fired facility operated by operated by Oglethorpe Power	In Georgia, approximately 31 mi south of the Keowee site	Operational (Oglethorpe Power 2010)
Plant Carl	A 25-MW generating plant fueled by wood and poultry waste	In Georgia, approximately 37 mi southwest of the Keowee site	Proposed by Earth Resources, Inc.(GDNR 2009)
Urquhart Station	A five-unit, 650-MW fossil-fueled power plant operated by South Carolina Electric and Gas	Approximately 110 mi southeast of the Keowee site	Operational (SCE&G 2009a)
Various small-scale fossil and cogeneration generating facilities	Fossil fuel-fired and cogeneration facilities	In Georgia, North Carolina, and South Carolina throughout the 50-mi region	Operational
Hydroelectric Energy Facilities			
Keowee Hydroelectric Generating Plant	A 158-MW hydroelectric facility operated by Duke Energy	Approximately 1 mi north of the Keowee site	Operational (Duke Energy 2010q)

Table 9-10. (contd)

Project Name	Summary of Project	Location	Status
Jocassee Hydroelectric Station	A four-unit 610-MW pumped-storage hydroelectric facility operated by Duke Energy	On the Keowee River approximately 12 mi north of the Keowee site	Operational (Duke Energy 2010r)
Bad Creek Hydroelectric Station	A four-unit 1065-MW pumped-storage hydroelectric facility operated by Duke Energy	Approximately 17 mi north-northwest of the Keowee site	Operational (Duke Energy 2011c)
Yonah Hydroelectric Plant	A 22.5-MW hydroelectric facility operated by Georgia Power	In Georgia, approximately 26 mi west of the Keowee site	Operational (Georgia Power 2010)
Tugalo Hydroelectric Plant	A 45-MW hydroelectric facility operated by Georgia Power	In Georgia, approximately 27 mi west of the Keowee site	Operational (Georgia Power 2010)
Tallulah Falls Hydroelectric Plant	A 72-MW hydroelectric facility operated by Georgia Power	In Georgia, approximately 29 mi west of the Keowee site	Operational (Georgia Power 2010)
Hartwell Dam and Lake	USACE dam with four 85-MW units and one 80-MW unit	On the Savannah River approximately 29 mi south of the Keowee site	Operational (USACE 2010a)
Nantahala hydro plants (including Thorpe)	11 hydroelectric generating plants with a total maximum capacity of 100 MW.	In North Carolina approximately 34-40 mi north-northwest of the Keowee site	Operational (Duke Energy 2011d)
Various small-scale hydroelectric projects located on dams, including Ware Shoals, Tennessee Creek, Pelzer Upper and Lower, Terrora and Tuckasegee projects	Run-of-river and dam storage hydroelectric projects ranging from 1-20 MW	In Georgia and South Carolina throughout the 50-mi region	Operational (USSD 2010)
Other Energy Projects			
DOE Savannah River Site	Research and industrial complex	Approximately 126 mi southeast of the Keowee site	Operational (DOE 2009c)

Table 9-10. (contd)

Project Name	Summary of Project	Location	Status
Energy Efficiency and Conservation Block Grant (EECBG) for City of Clemson	$78,000 funded to improve energy efficiency and conservation		In progress (ARRA 2011)
EECBG Grant for City of Easley	$203,000 funded to improve energy efficiency and conservation	16 mi from Keowee site	In progress (ARRA 2011)
State Energy Program Grant	$122,000 funded to public school districts, public colleges/ universities, and state agencies for improving EE	12.3 mi from Keowee site	In progress (ARRA 2011)
Transportation Projects			
South Carolina Strategic Corridor System Plan	Strategic system of corridors forming the backbone of the State's transportation system	Statewide	Planning document with no explicit schedules for projects; however, many strategic corridors coincide with routes that would/could be used for development at the Keowee site.
U.S. Department of Transportation (USDOT) Grant	$2.5 million funded to improve public transportation through purchasing new buses as well as software/ hardware for technology upgrades for all rural transit providers	Within 10 mi of the Keowee site	In progress (ARRA 2011)
Highway Infrastructure USDOT Grants	$4.6 million funded to improve highway infrastructure as well as enhance sidewalks	Within 15 mi of the Keowee site	Complete (ARRA 2011)
Other Facilities			
Fabric Mills including Milliken, Hollingsworth, and Alice Manufacturing	Fabric and yarn manufacture	Throughout the 50-mi region	Operational (EPA 2010ao)

Table 9-10. (contd)

Project Name	Summary of Project	Location	Status
Honeywell Nylon	Nylon and resin manufacture	In Anderson and Clemson, SC	Operational (EPA 2010ao)
Westpoint Stevens – Clemson Facility	Fabric mill	Approximately 10 mi south of Keowee	Operational (EPA 2011g)
BASF Corporation	Inorganic chemicals and secondary smelting of non-ferrous metals	Approximately 10 mi south-southwest of Keowee site	Operational (EPA 2011h)
Ryobi Motor Products	Power-driven hand tool manufacture	Approximately 14 mi northeast of the Keowee site	Operational (EPA 2010ao)
Jocassee Gorges Management Area	43,500 ac of land managed primarily as a natural area	Approximately 15 mi north of Keowee	Operational (SCDNR 2011e)
Michelin Manufacturing	Tires and rubber products	In Silver Springs, Starr and Greenville, SC	Operational (EPA 2010ao)
Parks and National Forests			
Sumter National Forest	371,000-ac national forest	Throughout 40- to 50-mi region	Currently managed by U.S. Forest Service (USFS 2004a)
Chattahoochee – Oconee National Forests	750,000-ac Chattahoochee National Forest, and 115,000-ac Oconee National Forest	Throughout 40- to 50-mi region	Currently managed by U.S. Forest Service (USFS 2004b). Recent land transfers have added additional acreage to the managed forest (USFS 2010b). Development likely limited in these areas.
Mile Creek County Park	County park offers camping, picnic area, swimming, and boating	Approximately 5 mi north of Keowee site	Operational (Oconee County 2011)

Table 9-10. (contd)

Project Name	Summary of Project	Location	Status
Other State parks, forests and wilderness areas	Numerous State Parks, Wildlife Management Areas, and Wilderness Areas including Tallulah Gorge State Park, Jocassee Gorges Management Area, Table Rock State Park, and Mountain Bridge Wilderness Area	Throughout the 50-mi region	Development likely limited in these areas.
Wastewater-Treatment Facilities			
Greenville/Adkins Water Treatment Plant	Water supply, non-major	Approximately 4 mi northeast of Keowee site	Operational (EPA 2011i)
Cochran Road Wastewater-Treatment Plant	Wastewater-treatment plant, major NPDES, located in Clemson, South Carolina	Approximately 7 mi southeast of Keowee site	Operational (EPA 2011j)
12 Mile RV and Wolf Creek Waste Water Treatment Plant	Wastewater-treatment plant, major NPDES	Approximately 10 mi northeast of Keowee site	Operational (EPA 2011k)
Pickens County Middle Regional Waste Water Treatment Plant	Wastewater-treatment plant, major NPDES	Approximately 10 mi southeast of Keowee	Operational (EPA 2011l)
City of Pickens Water Treatment Plant	$15.9 million funded to construct a water-treatment plant	12.5 mi from Keowee site	In progress (ARRA 2011)
Big Creek East Waste Water Treatment Plant	Improvements to take effluents out of Saluda River	Approximately 26 mi east-southeast of the Keowee site	Operational. Proposed improvements funded (ARRA 2011).
Minor water dischargers and wastewater-treatment plants	NPDES-permitted municipal and industrial discharges.	Throughout the 50-mi region	Operational

Table 9-10. (contd)

Project Name	Summary of Project	Location	Status
Other Projects/Activities			
Surface mines including the Crowder Construction Six Mile Pit, Oconee County Quarry, the Commerce Pit, and the Greentree Pit	Surface mining operations for construction materials	Various locations within the region	Operational (EPA 2010ao)
Various hospitals	Medical isotopes	Within the 50-mi region	Operational in Oconee and Pickens Counties
Commercial dairies and poultry farms including Cobb-Vantress and Columbia	Commercial production of animal products	In Georgia, North Carolina, and South Carolina throughout the 50-mi region	Operational (South Carolina Dairy Association 2010)
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and railroad; construction of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents.	Throughout region.	Construction would occur in the future, as described in State and local land-use planning documents
ARRA Capitalization Grant for City of Clemson	$288,000 funded for wastewater-treatment facilities and green infrastructure that will preserve and create jobs and promote economic recovery	Within 10 mi of the Keowee site	In progress (ARRA 2011)

Table 9-10. (contd)

Project Name	Summary of Project	Location	Status
Oconee County School District Grants	$16.6 million funded to support public elementary, secondary, and post-secondary education as well as early childhood education, education for children with disabilities (including ages 3–5), improving teaching and learning for students most at risk of failing	Within 10 mi of the Keowee site	In progress (ARRA 2011)
Pioneer Rural Water District ARRA Grant	$1.6 million funded for the construction of drinking-water facilities, green infrastructure, program administration, and drinking-water-related activities	14.2 mi from Keowee site	In progress (ARRA 2011)
Town of Pendleton Capitalization Grants	$3.6 million funded for constructing wastewater-treatment facilities, green infrastructure, nonpoint source projects, estuary projects and program administration to promote economic recovery	10.7 mi from Keowee site	In progress (ARRA 2011)
Southside Rural Community Water District Safe Drinking Water Grant	$1.4 million funded for the construction of drinking-water facilities, green infrastructure, program administration, and drinking-water-related activities	11.1 mi from Keowee site	In progress (ARRA 2011)

Table 9-10. (contd)

Project Name	Summary of Project	Location	Status
Pickens County School District Grants	$11.6 million funded to improve education to children with disabilities, students at risk of failing, improve education for homeless/ less fortunate students, and for improving EE	13.5 mi from Keowee site	In progress (ARRA 2011)
Pickens City Community Block Grant	$3.4 million funded to modernize infrastructure and public facilities that provide basic services to residents and promote EE and conservation as well as provide jobs to the people	12 mi from Keowee site	In progress (ARRA 2011)

The Keowee site is a wooded greenfield site located approximately 1 mi south of the Oconee Nuclear Station. The Keowee site is wholly owned by Duke, and is maintained as forested land. Figure 9-5 shows the Keowee site region.

The Keowee site is located in the northwest portion of Duke's service territory. The western edge of the Keowee site is bound by US-130, on the north by US-183, and on the east by the Keowee River. The area is predominantly rural; however, sparse populations, including some residential developments, exist west of the site between US-130 and Lake Keowee. The nearest population centers are Seneca and Clemson, South Carolina, which are both approximately 7 mi south of the site; Anderson, South Carolina, which is approximately 21 mi southeast of the site; and Greenville, South Carolina, which is approximately 27 mi east of the site.

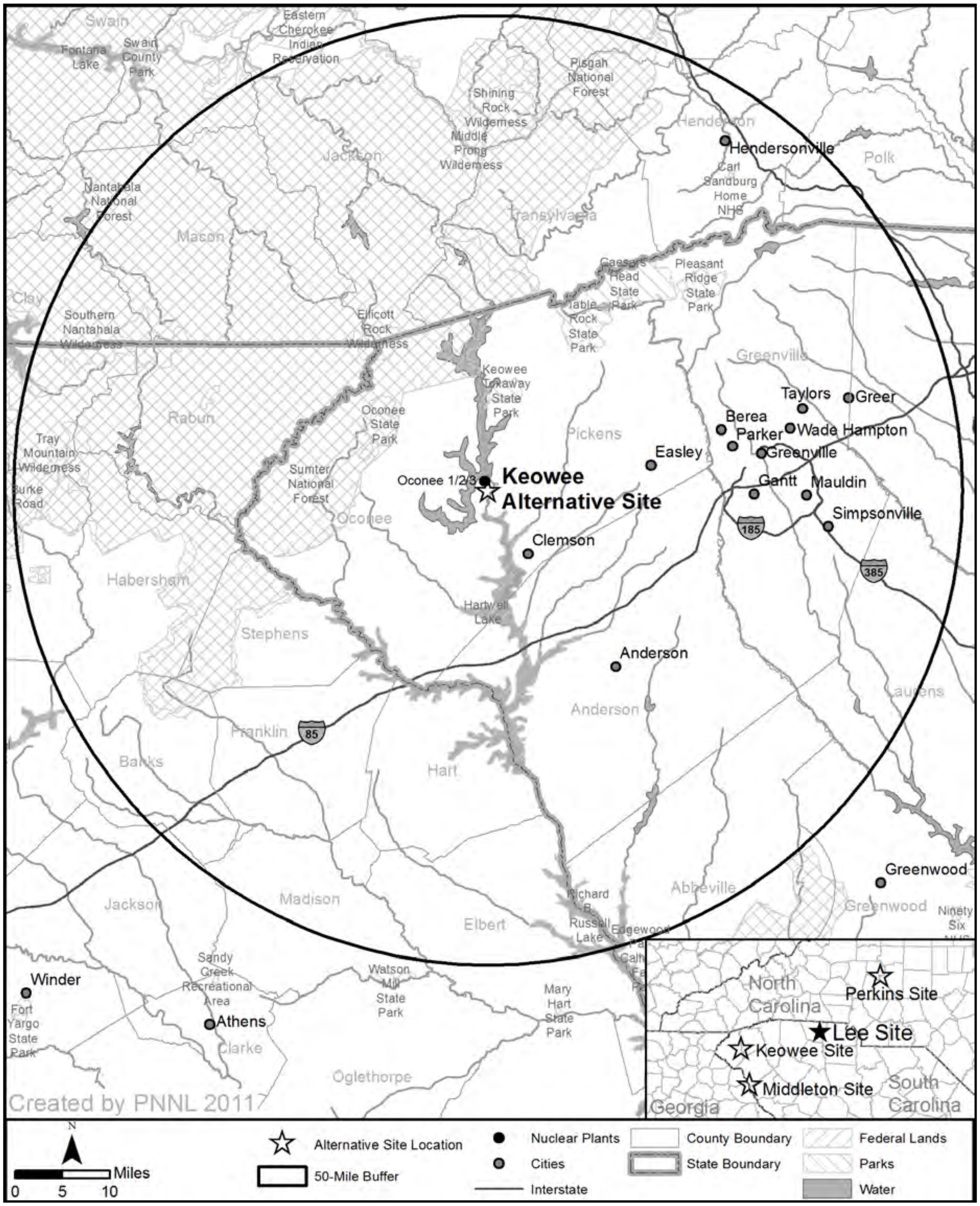

Figure 9-5. The Keowee Site Region

9.3.4.1 Land Use

The following analysis addresses impacts on land use from building and operating two new nuclear generating units at the Keowee site in Oconee County, South Carolina. In addition to land-use impacts from building and operations, the cumulative analysis for the Keowee site considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative land-use impacts, including other Federal and non-Federal projects and the projects listed in Table 9-10.

Site Description

The Keowee site in Oconee County is located near the northwest border of South Carolina, adjacent to the Oconee Nuclear Station. The site is not in the coastal zone. The Keowee site is a greenfield site currently managed as forested land. The site would require extensive grading and the development of an offsite supplemental water reservoir (Duke 2009b). Building a nuclear facility on the Keowee site would require the relocation of an existing road that runs next to the site, also a new access road to the site would be built (Duke 2009c). The surrounding vicinity of the site has a low level of development but the location near the water intake structure has a high level of residential development (Duke 2009c).

Building and Operation Impacts

The Keowee site would require significant grading and cut-fill activities to support a two-unit nuclear power facility (Duke 2009c). Based on information provided by the applicant and the review team’s independent assessment, development of the proposed new units would require about 450 ac onsite (Duke 2009c) and 1300 ac offsite for a supplemental water reservoir (Duke 2009b). An 8.8-mi railroad spur to support construction deliveries and approximately 4 mi of cooling-water pipeline would be built as well (Duke 2010g). Table 9-11 summarizes expected land-use impact parameters for the Keowee site, the supplemental water reservoir, and ancillary facilities.

Table 9-11. Land-Use Impact Parameters for the Keowee Site

Parameter	Value	Source
Required project area	450 ac	Duke (2009c)
Number of supplemental water reservoirs	1	Duke (2009c)
Supplemental water reservoirs, area required	1300 ac	Duke (2009c)
Ancillary facilities	130 ac	Duke (2010g)
Number of new transmission-line routes	1	Duke (2010g)
Total transmission-line corridor distance (270-ft-wide corridor)	1.3 mi	Duke (2010g)
Railroad spur distance (100-ft-wide corridor)	8.8 mi	Duke (2010g)
Cooling-water pipeline (50-ft-wide corridor)	4.0 mi	Duke (2010g)

Due to the proximity of the Oconee switchyard, only a short distance (1.3 mi) of transmission lines would be needed (Duke 2010g). Land currently used for forests or timber production would be altered, replaced with grasses and other types of ground cover (Duke 2009c).

Cumulative Impacts

For the analysis of land-use impacts at the Keowee site, the geographic area of interest is considered to be the 50-mi region centered on the Keowee site, which includes all transmission-line corridors. Land-use planning for transmission-line routing over wide areas must consider land-use plans of adjoining counties and other land-managing agencies, rather than considering one county in isolation. Furthermore, in predominantly rural settings such as that surrounding the Keowee site, land-use changes occurring substantial distances away from a project site can substantially influence land-use planning decisions close to the site. Roads and other public facilities and services in rural areas tend to serve people who are spread thinly but broadly over large portions of the landscape. Therefore, land-use changes can affect roads and other facilities at greater distances than similar changes in more densely populated areas.

Several State, U.S., and interstate highways currently traverse the area. The proposed project would indirectly result in land conversions to residential areas, roads, and businesses to accommodate growth, new workers, and services related to the proposed nuclear facility. Other reasonably foreseeable projects in the area that could contribute to an increase in urbanization include potential development of new residences within easy commuting distance of the new plant and the development and upgrading of local roads and highways. Because the other projects described in Table 9-10 do not include any reasonably foreseeable changes in land-use types within 50 mi of the Keowee site, other than general growth and urbanization development, there would not be any significant additional cumulative impacts on land use from those activities.

As described above, building the proposed facilities, development of new transmission-line corridors, inundation to create a supplemental reservoir, and building the water intake and railroad spur to support the new units may affect approximately 1880 ac of land. The overall land-use impacts of these activities would be noticeable and permanent, particularly in the area containing the supplemental pond. If additional transmission lines are built from other energy projects, there would be a cumulative land-use impact from the additional amount of land converted to utility corridor use for transmission lines. Because transmission lines are often co-located and are relatively narrow, the review team expects that the cumulative impact would be consistent with the land-use plans and zoning regulations of the affected counties. Nonetheless, consistent with previous discussions, new transmission-line corridors could noticeably alter the land-use classification acreage proportions, within the geographic area of interest.

Due to the potential reclassification of acreage within the region caused by the transmission-line development and the supplemental pond, the review team concludes that the cumulative land-use impacts associated with the proposed project at the Keowee site, and other projects in the geographic area of interest would be MODERATE. Considering the land needs noted above, building and operating two new nuclear units at the Keowee site would be a significant contributor to these impacts.

9.3.4.2 Water Use and Quality

This section describes the review team's assessment of impacts on water use and quality associated with building and operating two new nuclear units at the Keowee site. The assessment considers other past, present, and reasonably foreseeable future actions that affect water use and quality, including the other Federal and non-Federal projects listed in Table 9-10. The Keowee site hydrology, water use, and water quality are discussed in the ER (Duke 2009c) and in the response to a RAI (Duke 2010l).

The geographic area of interest for the Keowee site is the drainage basin of the Keowee and Little Rivers upstream of the site and the Seneca and Savannah Rivers downstream of the site because these are the resources that would be affected if the proposed project were located at the Keowee site. For groundwater, the geographic area of interest is limited to the site because Duke has indicated no plans for use of groundwater to build and operate the plant (Duke 2009c).

The cooling- and service-water supply for a two-unit nuclear generating station located at the Keowee site would be Lake Keowee. Lake Keowee has a full pond elevation of 800 ft mean sea level (msl) and cannot be drawn down below 794.6 ft without negatively affecting the operation of Oconee Nuclear Station. The Keowee River is not listed as impaired by South Carolina for any water-quality parameters although the Savannah River downstream of the site is listed as impaired for mercury, fecal coliform, and turbidity (EPA 2010am).

Building Impacts

Because the building activities at the Keowee site would be similar to those at the Lee Nuclear Station site, the review team estimated that the water needed for building activities at the Keowee site would be identical to the proposed amount of water use for building at the Lee Nuclear Station site. Consistent with the Lee Nuclear Station, the review team assumed that groundwater would not be used. During building activities at the Lee Nuclear Station site, the average estimated water use is projected to be 250,000 gpd or 0.39 cfs (Table 3-5). This water-use rate is inconsequential when compared to the volume of Lake Keowee. The review team assumed that building activities could cease, if needed, during very low lake level conditions without any significant overall impact on the schedule. Because the surface-water withdrawal would be minor compared to the volume of the lake and because the withdrawal from the lake would be temporary and limited to the building period, the review team concludes that the impact of surface-water use for building the two new nuclear units at the Keowee site would be minimal.

Duke stated that it would need to build a reservoir at the Keowee site to provide sufficient water for continual operation of the two units based on an analysis using the worst-case drought of record. This analysis indicated that water from another source would be needed for new nuclear units for a period of 169 days should a similar drought occur in the future (Duke 2010l). Development of this site for two nuclear units would require the building of a water reservoir with a storage capacity of 80,000 ac-ft on the Keowee site supplied with water from Lake Keowee that could supply water for plant operations during droughts. Duke would dam the drainage of one tributary creek to the Keowee River to create the storage volume needed to supply the supplemental condenser cooling water during future droughts of the magnitude experienced during the historic worst-case drought (Duke 2010l). Because a single creek would be affected and the drainage area is small relative to the area of the Keowee-Savannah River Basin, changes to flow in the Keowee-Savannah River system as a result of building the reservoir would not be detectable.

As stated above, the review team assumed that no groundwater would be used to build the units at the Keowee site. The review team also assumed that the impact of dewatering the excavations needed for building two units at the site would be temporary and minor at the Keowee site because technology (such as slurry walls, grouting) is readily available to control water inflow to the excavation if needed. Therefore, because there would be no groundwater use and the impact of dewatering would be temporary and minor, the review team determined that there would be minimal impact on groundwater resources.

Surface-water quality could be affected by stormwater runoff during site preparation and the building of the facilities. The SCDHEC would require Duke to develop a SWPPP. The SWPPP would identify BMPs to control the impacts of stormwater runoff. The review team anticipates that Duke would construct new detention and infiltration ponds and drainage ditches to control delivery of sediment from the disturbed area to nearby waterbodies. Sediment carried with stormwater from the disturbed area would settle in the detention ponds and the stormwater would infiltrate into the shallow aquifer. As a result, stormwater runoff is not anticipated to affect water quality in Lake Keowee. Therefore, during building activities, the surface water-quality impacts near the Keowee site would be temporary and minimal.

While building new nuclear units at the Keowee site, impacts on groundwater quality may occur from leaching of spilled effluents into the subsurface. The review team assumes that the BMPs Duke has proposed for the Lee Nuclear Station site would also be in place during building activities at the Keowee site, and therefore the review team concludes that any spills would be quickly detected and remediated. As discussed in Section 4.2.3.1, the development of an SWPPP with its call for implementation of BMPs would minimize water-quality impacts.

Because any spills related to building activities would be quickly remediated under BMPs, and the activities would be temporary, the review team concludes that the groundwater-quality impacts from building at the Keowee site would be minimal.

Operational Impacts

The review team assumed that the cooling-water system for the proposed plant, if built and operated at the Keowee site, would be similar to that proposed at the Lee Nuclear Station site; specifically, the cooling-water system would use cooling towers and blowdown would be discharged to the Lake Keowee.

Duke proposes that cooling water be withdrawn from Lake Keowee. A cooling-water reservoir with a storage capacity of 80,000 ac-ft at the Keowee site supplied with water from Lake Keowee would provide supplemental water when adequate water from the lake may not be available (Duke 2010l). Duke did not provide details of the cooling-water intake and effluent discharge locations. However, it is standard practice for power plants to design cooling-water intake and effluent discharge locations such that recirculation of discharged effluent to the intake does not occur.

Duke determined that the total amount of water withdrawn from the water source to operate two units would be approximately 35,000 gpm (78 cfs). Approximately 2000 gpm (4.5 cfs) would be used for the screen wash system and thus return to the river at the intake location. As indicated for the Lee Nuclear Station in Chapter 3, consumptive losses through evaporation and drift from cooling two units would be approximately 24,700 gpm (55 cfs) (Duke 2009c). The remaining 18 cfs would be returned via pipeline to the lake at the discharge location.

The source of water for this site would be from Lake Keowee, which would support the 55 cfs consumptive withdrawal for the new units. An 80,000 ac-ft supplemental water reservoir would need to be built to supply water during low water availability periods in Lake Keowee so operation of Oconee Nuclear Station, also located on Lake Keowee, would not be affected and the minimum release flows from Lake Keowee could be maintained.

When water level in Lake Keowee drops below 794.6 ft msl, water from a supplemental water-storage reservoir would be required or operation of the plant would need to be curtailed. The proposed 80,000 ac-ft reservoir would allow the plant to operate for approximately 169 days (Duke 2010l). Based on the small fraction of available water that would be used during normal flow conditions and the availability of the proposed water-storage reservoir for use during low-flow periods, the review team determined that the operational impact of the proposed plant at the Keowee alternative site on surface water would be minimal. Similar to the Lee Nuclear Station, the reservoir refill rate was assumed to be 200 cfs. This would be limited based on current lake conditions and would only be used after the reservoir had been drawn down to provide water for plant operation during drought periods.

As stated above, the review team assumed that no groundwater would be used to operate the units at the Keowee site. Therefore, because there would be no groundwater use, the review team determined that there would be no impact on groundwater resources.

During the operation of the proposed plant at the Keowee site, impacts on surface-water quality could result from stormwater runoff, discharges of treated sanitary and other wastewater, and blowdown from cooling towers into the Lake Keowee. The review team assumed that the blowdown rate would be the same as that at the Lee Nuclear Station site, 8216 gpm (18 cfs). Blowdown would be regulated by SCDHEC pursuant to 40 CFR Part 423 and all discharges would be required to comply with limits established by the SCDHEC in an NPDES permit.

The SCDHEC would require Duke to develop a SWPPP. The plan would identify measures to be used to control stormwater runoff. Because stormwater controls would be in place and blowdown discharges would be regulated under an NPDES permit, the review team concludes that the impacts on surface-water quality from operation of two nuclear units at the Keowee site would be minimal.

During the operation of new nuclear units at the Keowee site, impacts on groundwater quality could result from potential spills. Spills that might affect the quality of groundwater would be prevented or remediated by using BMPs. Because BMPs would be used to quickly remediate spills and no intentional discharge to groundwater should occur, the review team concludes that the impacts on groundwater quality from operation of two nuclear units at the Keowee site would be minimal.

Cumulative Impacts

In addition to water-use and water-quality impacts from building and operations activities, cumulative impacts analysis considers other past, present, and reasonably foreseeable future actions the affect the same environmental resources. For the cumulative analysis of impacts on surface water, the geographic area of interest for the Keowee site is the drainage basin of the Keowee and Little Rivers upstream of the site and the Seneca and Savannah Rivers downstream of the site because these are the resources that would be affected if the proposed project were located at the Keowee site. For groundwater, the geographic area of interest is limited to the alternative site because Duke has indicated no plans for use of groundwater to build and operate the plant (Duke 2009c).

Key actions that have past, present, and future potential impacts on surface-water supply and surface-water quality in this drainage basin include the operation of the dams that form Lake Keowee and other dams and reservoirs downstream of the Keowee site. Lake Keowee is created by dams on the Keowee River (Keowee Dam) and on the Little River (Little River Dam). Upstream of Lake Keowee is the Jocassee Hydro Station, a 610-MW pumped-storage facility that creates Lake Jocassee. Downstream of the site are Hartwell Dam, Russell Dam and Thurmond Dam. These dams serve to increase the reliability of water supply to the region and to provide power.

The Oconee Nuclear Station, which includes three 846-MW units and is located adjacent to the Keowee site, has past, present, and future impacts on water quality and water supply in the region because it uses Lake Keowee as a source of cooling water. Additional actions that have past, present, and future potential impacts on water supply and water quality in the Savannah River Basin include operating South Carolina Electric and Gas' (SCE&G's) Urquhart Station (a fossil-fueled electrical generating plant) (SCE&G 2009a), operating and decommissioning DOE facilities at the Savannah River Site (SRS), operating two existing nuclear power plants at the Vogtle site, building and operating two new power plants at the Vogtle site, and other municipal and industrial activities in the Savannah River Basin.

The GCRP has compiled the state of knowledge in climate change (GCRP 2009). This compilation has been considered in the preparation of this EIS. The projections for changes in temperature, precipitation, droughts, and increasing reliance on aquifers within the Keowee River Basin are similar to those at other alternative sites in the region. These regional changes are discussed in Section 7.2 of this EIS.

Cumulative Water Use

Based on a review of the GCRP assessment of the Southeast United States region, the review team conservatively estimated a decrease in streamflow of 10 percent over the life of the station. This reduction in streamflow would result in a higher incidence of times when the Keowee reservoir water level drops below 794.6 ft msl. As discussed above, when the water level in Lake Keowee drops below 794.6 ft msl, water from a supplemental water-storage reservoir would be required or operation of the plant would need to be curtailed. The review team also considered the increased water demands associated with an increased population in the region. The South Carolina Department Natural Resources (SCDNR) indicated that "water demand for industry, public supply, crop and golf course irrigation, and domestic use is expected to increase by nearly 50 percent between the years 2000 and 2045" (SCDNR 2004).

By considering the impact of climate change on historical flows and allowing for continued increase in water demand due to population growth in the region, the review team determined that the reservoir would be needed more frequently as time goes on and, in some instances, the plant would exhaust its water supply and the units might be required to derate or cease operation.

The impacts of the other projects listed in Table 9-10 are considered in the analysis included above or would have little or no impact on surface-water use. The projects believed to have little impact are excluded from the analysis either because they are too distant from the Keowee site, use relatively little or no surface water, or have little or no discharge to surface water. Some projects (e.g., park and forest management) are ongoing, and changes in their operations that would have large impacts on surface-water use appear unlikely.

The review team determined that the cumulative impacts on water supply associated with operation of the proposed units, other water users, climate change, and population growth would be MODERATE, but the incremental impact associated with water use for the Keowee site was determined not to be a significant contributor to this MODERATE impact.

As stated above, the review team assumed that no groundwater would be used to build or operate the units at the Keowee site and that groundwater impacts from dewatering would be temporary and minor. Therefore, the review team determined that the Keowee site by itself would have minimal impact on groundwater resources.

Other projects listed in Table 9-10 are either currently in operation (for example the Oconee Nuclear Station, Units 1, 2, and 3) or are 10 or more miles away from the Keowee site. Therefore, the impact of operation of these projects is included in the current hydrology analysis or will not contribute to a cumulative impact on groundwater supply within the ROI. Because groundwater-use impacts are limited and temporary due to aquifer dewatering during the building phase, and other projects are not anticipated near the Keowee site, the review team concludes that cumulative impacts on groundwater use at the alternative site would be SMALL.

Cumulative Water Quality

Point and nonpoint sources have affected the water quality of the Keowee and Little Rivers upstream of the Keowee site and the Seneca-Savannah River system downstream of the site. As mentioned above, the Savannah River downstream of the alternative site location is listed as impaired for use due to mercury, fecal coliform, and turbidity (EPA 2010am). The impacts of other projects listed in Table 9-10 are either considered in the analysis included above or would have little or no impact on surface-water quality. Therefore, the review team concludes that the cumulative impact on surface-water quality of the receiving waterbody would be MODERATE. Water-quality information presented above for the impacts of building and operating the proposed new units at the Keowee site would also apply to evaluation of cumulative impacts. As mentioned above, the State of South Carolina requires an applicant to develop an SWPPP. The plan would identify measures to be used to control stormwater runoff. The blowdown would be regulated by EPA pursuant to 40 CFR Part 423 and all discharges would be required to comply with limits established by the SCDHEC in a NPDES permit. Such permits are designed to protect water quality. Therefore, because industrial and wastewater discharges from the proposed units would comply with NPDES permit limitations and any stormwater runoff from the site during operations would comply with the SWPPP, the review team concludes that building and operating the proposed units at the Keowee site would not be a significant contributor to cumulative impacts on surface-water quality.

With the exception of the Oconee Nuclear Station and the Keowee Hydroelectric Station, other projects listed in Table 9-10 are 10 or more miles away from the Keowee site and thus will not contribute to a cumulative impact on groundwater quality near the site. The Oconee Nuclear

Station has reported elevated tritium concentrations in groundwater onsite (NRC 2010f) although groundwater offsite has not been affected. Operation of the Keowee Hydroelectric Station is not anticipated to have a noticeable effect on groundwater quality. The review team also concludes that with the implementation of BMPs, the impacts on groundwater quality from building and operating two new nuclear units at the Keowee site would likely be minimal. Therefore, the cumulative impact on groundwater quality would be SMALL.

9.3.4.3 Terrestrial and Wetland Resources

The following analysis includes impacts from building and operating the proposed new facilities on terrestrial ecology resources at the Keowee site. The analysis also considers past, present, and reasonably foreseeable future actions that affect the terrestrial ecological resources, including other Federal and non-Federal projects and the projects listed in Table 9-10. For the analysis of terrestrial ecological impacts at the Keowee site, the geographic area of interest includes the portions of Anderson, Oconee, and Pickens Counties that are within a 15-mi radius of the Keowee site. This area encompasses the supplemental water reservoir and all the ancillary facilities (one transmission line, a cooling-water pipeline, and a railroad spur), and the important animal and plant species and communities that could be potentially affected. The 15-mi distance was used by the SCDNR for their species and habitat of concern occurrence analysis.

In developing this EIS, the review team relied on reconnaissance-level information to perform the alternative site evaluation in accordance with ESRP 9.3 (NRC 2000a). Reconnaissance-level information is data that are readily available from agencies and other public sources such as scientific literature, books, and Internet websites. It also can include information obtained through site visits. To identify terrestrial resources at the Keowee site, the review team relied primarily on the following information:

- Oconee Nuclear Station Final Environmental Report (Duke Energy 1998) and Environmental Impact Statement for license renewal (NRC 1999b)
- Lee Nuclear Station COL ER and supplement (Duke 2009b, c)
- Lee Nuclear Station Joint Application for Activities Affecting Waters of the United States submitted by Duke (2011h) to the USACE
- a tour of the Keowee alternative site in April 2008 (NRC 2008d) and a tour of the Keowee alternative site and supplemental cooling-water reservoir site in August 2010 (NRC 2010c)
- responses to RAIs provided by Duke (2010g)
- FWS Endangered Species Program database for South Carolina (FWS 2012a) and South Carolina Natural Heritage Program (SCDNR 2012j, 2012n, 2012o) county record information
- correspondence regarding species and habitat occurrences from the SCDNR (SCDNR 2012b).

Site Description

The Keowee site is situated within the Piedmont ecoregion in South Carolina (Griffith et al. 2002). As described in Section 7.3.1, the Piedmont ecoregion has been altered to a great extent since European settlement, primarily because of farming, agriculture, and silviculture. Existing forests in the area are second growth, and are now dominated by loblolly (*Pinus taeda*), shortleaf (*P. echinata*), and Virginia (*P. virginiana*) pines mixed with red and white oak (*Quercus rubra*, *Q. alba*), hickory (*Carya* sp.), and tulip poplar (*Liriodendron tulipifera*) (Duke Energy 1998).

Duke provided a description of the vegetation cover types within a 2500-ft radius of the center of the Keowee site. The cover types are mixed hardwood (212 ac), pine (122 ac), mixed hardwood/pine (46 ac), pine/mixed hardwood (39 ac), open water (18 ac), and open/field/meadow (13 ac). Wetland and upland scrub cover types do not occur within this area (Duke 2009b). Hardwood and mixed hardwood forest, which provide higher-quality habitat to wildlife than pine or open/field/meadow, comprise 258 ac or about 57 percent of the Keowee site. A partial field survey of the Keowee site, conducted in 1998 as part of the Oconee Nuclear Station license renewal environmental review (Duke Energy 1998), identified several areas that retained characteristics of mature upland forest that Duke designated as protected natural areas. As described in Section 9.3.4.1, operation of new facilities at the Keowee site would require one offsite supplemental cooling-water reservoir, and ancillary facilities consisting of a railroad spur, a transmission line, and a cooling-water pipeline.

The staff visited the Keowee site in April 2008 (NRC 2008d) and the Keowee site and the site of the supplemental cooling-water reservoir and surrounding area in August 2010 (NRC 2010c). The Clemson University Experimental Forest and associated stream system, located in Pickens County, South Carolina, is representative of much of the habitat that surrounds the stream system at the site of the cooling reservoir. This forest consists largely of abandoned cotton farms that have returned to second growth hardwood or mixed hardwood/pine forest (Clemson University 2009). The Clemson University Experimental Forest supports a mature bottomland forest, an expansive floodplain, extensive alluvial wetlands, and diverse and abundant amphibian, reptile, and bird populations (Clemson University 2008).

Federally Listed and State-Ranked Species

Duke provided no new field survey information for the Keowee site beyond its partial characterization in 1998 for the Oconee Nuclear Station license renewal ER (Duke Energy 1998). The review team is unaware of any field surveys of the site of the cooling-water reservoir, the transmission-line corridor, water-pipeline corridor, or railroad corridor.

The presence/absence of Federally listed and State-ranked species in the project footprint cannot be ascertained without field surveys. However, a query of the South Carolina rare, threatened, and endangered species inventory database (SCDNR 2012b) indicates the presence of approximately 120 plant and animal species and communities within 15 mi of the Keowee site that are either Federally listed as threatened or endangered, candidates for listing, and/or are ranked by the State of South Carolina as critically imperiled, imperiled, or vulnerable. The State ranking (in addition to the Federal listing) provides the only common basis for comparing numbers of important animal and plant species among the Lee, Perkins, Keowee, and Middleton Shoals sites. Peregrine falcons (*Falco peregrinus anatum*) have been introduced in the area of Jocassee Dam north of the Keowee site, but are not known to reside near the Oconee or Keowee sites (NRC 1999b). This species is not State-ranked, but has been assigned a State protection status as threatened (Table 9-12).

The vast majority of the approximately 120 species identified in the database queries are highly unlikely to occur at either the Keowee site or the site of the supplemental cooling-water reservoir because of habitat affinities that are significantly different from habitat conditions at these locations. The northern portions of Oconee and Pickens Counties, beginning about 10 mi north of the Keowee site, lay within the Blue Ridge ecoregion, which differs significantly from the Piedmont ecoregion in geology, elevation, and precipitation (Griffith et al. 2002; SCDNR 2005). For example, the Blue Ridge ecoregion constitutes about 1.7 percent of the total land area of South Carolina (SCDNR 2005), but it harbors 40 percent of the State's rare plant species (TNC 2011). The query of the SCDNR database identified approximately 100 plant species within 15 mi of the Keowee site in Anderson, Oconee, and Pickens Counties that are ranked as critically imperiled, imperiled, or vulnerable (SCDNR 2012b). In contrast, Anderson County lies entirely within the Piedmont ecoregion and has less than 10 such plant species (SCDNR 2012n). Because the majority of the species are highly unlikely to occur on either the Keowee site or the site of the supplemental cooling-water reservoir, they should not serve as a basis to compare potential impacts among the alternative sites. Consequently, the list of State-ranked plant species was screened using habitat and county distribution information provided by Weakley (2010) and NatureServe Explorer (2010); this resulted in the identification of 57 plant taxa potentially occurring near the site. The list of State-ranked animal species was similarly screened using habitat and county distribution information provided by Burt and Grossenheider (1980), Opler et al. (2011), Kaufman (2000), Menzel et al. (2003), NatureServe Explorer (2010), Savannah River Ecology Laboratory Herpetology Program (2011), and SCDNR (2005), resulting in the identification of seven species potentially occurring near the site. The resulting State-ranked animal and plant species that could potentially occur at the Keowee site or the site of the proposed cooling-water reservoir are listed in Table 9-12.

Table 9-12. Terrestrial Federally Listed and Candidate Species, and State-Ranked Species and Communities within 15 mi of the Keowee site in Oconee, Pickens, and Anderson Counties, South Carolina[(a)]

Scientific Name	Common Name	Federal Status[(b)]	SC State Rank/ Protection Status[(c)]	Counties of Occurrence	Habitat[(d)]
Mammals					
Neotoma floridana	eastern woodrat	-	S3	Oconee, Pickens	wooded areas, ravines, floodplain forest
Sylvilagus aquaticus	swamp rabbit	-	S2	Oconee, Pickens	mature forests in floodplains, bottomlands, riparian areas
Birds					
Accipiter cooperii	Cooper's hawk	-	S3	Oconee, Pickens	primarily mature forest, also open woodland and forest edge
Falco peregrinus anatum	American peregrine falcon	-	SNR/ST	Pickens	nests on cliffs and on tall buildings in cities[(e)]
Reptiles					
Pituophis melanoleucus	pine snake	-	S3	Pickens	xeric, pine-dominated or pine-oak woodland with an open, low understory on sandy soils
Invertebrates					
Autochton cellus	golden-banded skipper	-	S2 S4	Oconee	near streams in rich forests
Speyeria diana	Diana fritillary	-	S3?	Oconee	mixed forests with violets in the understory
Plants					
Agrimonia pubescens	soft groovebur	-	S1	Pickens	dry to moist forests and woodlands
Allium cernuum	nodding onion	-	S2	Oconee, Pickens	open woodlands or around outcrops
Aristolochia tomentosa	woolly Dutchman's-pipe	-	S1	Pickens	floodplain forests, disturbed areas
Arnoglossum muehlenbergii	great Indian plantain	-	S1	Pickens	cove forests, other mesic forests

Table 9-12. (contd)

Scientific Name	Common Name	Federal Status[(b)]	SC State Rank/ Protection Status[(c)]	Counties of Occurrence	Habitat[(d)]
Asplenium pinnatifidum	lobed spleenwort	-	S1	Pickens	moist to dry rock outcrops
Carex gracillima	graceful sedge	-	S2	Oconee, Pickens	moist ravine and slope forests, floodplains of rivers and large creeks
Carex prasina	drooping sedge	-	S2	Oconee, Pickens	rich forests, especially in seepage
Carex scabrata	rough sedge	-	S2	Oconee, Pickens	seepage slopes, brookbanks
Caulophyllum thalictroides	blue cohosh	-	S2	Oconee, Pickens	rich forests
Circaea lutetiana ssp. *canadensis*	Enchanter's nightshade	-	S3	Oconee, Pickens	mesic, nutrient-rich forests
Collinsonia verticillata	whorled horse-balm	-	S3	Anderson, Oconee, Pickens	rich moist (cove) forests to dry oak forests
Cypripedium parviflorum var. *pubescens*	large yellow lady's-slipper	-	S3	Oconee, Pickens	rich, mesic forests
Cystopteris protrusa	lowland brittle fern	-	S2	Oconee, Pickens	rich woods or moss- and soil-covered talus in boulder fields, occasionally on rock outcrops
Draba aprica	open-ground whitlow-grass	-	S1	Pickens	shallow soils around granitic flatrocks
Echinacea laevigata	smooth coneflower	E	S3	Anderson, Oconee, Pickens	open woodlands and glades
Euonymus atropurpureus	eastern wahoo	-	S1	Oconee, Pickens	bottomland forests, riverbanks
Eurybia avita	Alexander's rock aster	-	S1	Pickens	shallow soils on granitic flatrocks
Galearis spectabilis	showy orchis	-	S3	Oconee, Pickens	rich, deciduous forests
Gaylussacia baccata	black huckleberry	-	S1	Oconee, Pickens	xeric, acidic forests and woodlands, rock outcrops
Helenium brevifolium	shortleaf sneezeweed	-	S1	Oconee, Pickens	seepage bogs

Table 9-12. (contd)

Scientific Name	Common Name	Federal Status[b]	SC State Rank/ Protection Status[c]	Counties of Occurrence	Habitat[d]
Helianthus glaucophyllus	white-leaved sunflower	-	S2	Oconee, Pickens	moist forests, woodlands, and woodland edges
Helianthus porteri	Porter's goldeneye	-	S1	Pickens	shallow soils over granite on low-elevation granite domes or flatrocks
Hydrocotyle americana	American water-pennywort	-	S1	Oconee, Pickens	bogs, marshes, seepages
Isoetes melanospora	black-spored quillwort	E	S1	Pickens	pools on granite flatrocks
Isoetes piedmontana	Piedmont quillwort	-	S2	Pickens	seepage on granitic flatrocks
Juglans cinerea	butternut	-	S3	Oconee, Pickens	moist, nutrient-rich forests
Juncus georgianus	Georgia rush	-	S2	Pickens	shallow depressions in granitic outcrops
Liparis liliifolia	large twayblade	-	S1	Oconee, Pickens	moist forests, floodplains
Lonicera flava	yellow honeysuckle	-	S2	Oconee, Pickens	in soil mats around granitic domes
Lygodium palmatum	climbing fern	-	S3	Oconee, Pickens	bogs, moist thickets, swamp forests, sandstone outcrops, roadside ditches and roadbanks
Lysimachia fraseri	Fraser's loosestrife	-	S3	Anderson, Oconee, Pickens	hardwood forests, forest edges and roadbanks, thin soils around rock outcrops
Menispermum canadense	Canada moonseed	-	S2	Pickens	moist nutrient-rich forests, especially on floodplains or lower slopes
Minuartia uniflora	one-flower stitchwort	-	S3	Pickens	granitic flatrocks

Table 9-12. (contd)

Scientific Name	Common Name	Federal Status[(b)]	SC State Rank/ Protection Status[(c)]	Counties of Occurrence	Habitat[(d)]
Monotropsis odorata	sweet pinesap	-	S2	Oconee, Pickens	dry to mesic upland woods under oaks and/or pines
Nestronia umbellula	nestronia	-	S3	Oconee, Pickens	mesic to dry oak forests
Orobanche uniflora	one-flowered broomrape	-	S2	Oconee, Pickens	sandy streambanks and riverbanks, rich forests
Osmorhiza claytonii	hairy sweet-cicely	-	S2	Oconee, Pickens	cove forests, other moist, fertile forests
Pachysandra procumbens	Allegheny-spurge	-	S2	Oconee, Pickens	moist rich woods
Parnassia asarifolia	kidneyleaf grass-of-parnassus	-	S2	Anderson, Oconee	bogs, sphagnous seeps, brook banks
Pellaea atropurpurea	purple-stem cliff-brake	-	S1	Oconee, Pickens	outcrops of limestone and other rocks
Philadelphus hirsutus	streambank mock-orange	-	S2	Oconee, Pickens	bluffs, rock outcrops, rocky woodlands, often with seepage
Platanthera lacera	green-fringe orchis	-	S2	Pickens	swamps, bogs, seepages
Rudbeckia heliopsidis	sun-facing coneflower	-	S1	Oconee	limestone or sandstone streambanks and barrens, pinelands, roadsides
Ruellia caroliniensis ssp. *ciliosa*	sandhills wild petunia	-	S1	Pickens	dry to moist forests and woodlands
Sarracenia rubra ssp. *jonesii*	mountain sweet pitcher-plant	E	S1	Pickens	bogs, cataract seeps
Symphyotrichum georgianum	Georgia aster	C	SNR	Oconee	dry, rocky woodlands, woodland borders, roadbanks, powerline rights-of-way
Solidago bicolor	white goldenrod	-	S2	Oconee, Pickens	woodlands, roadbanks, pastures
Stachys latidens	broad-toothed hedge-	-	S2	Oconee, Pickens	mesic forests in coves and on

Table 9-12. (contd)

Scientific Name	Common Name	Federal Status[b]	SC State Rank/ Protection Status[c]	Counties of Occurrence	Habitat[d]
	nettle				mountain slopes, mountain pastures and forest edges
Tiarella cordifolia var. *cordifolia*	heart-leaved foam flower	-	S2	Oconee, Pickens	moist forests, cove forests, rock outcrops
Thermopsis mollis	soft-haired thermopsis	-	S1	Oconee, Pickens	dry slopes and ridges
Tridens chapmanii	Chapman's redtop	-	S1	Pickens	loamy sands of disturbed longleaf pine woodlands, roadsides
Trillium rugelii	southern nodding trillium	-	S2	Anderson, Oconee, Pickens	rich woodlands and forests over mafic or calcareous rocks
Viola pubescens (= *V. pensylvanica*)var. *leiocarpon*	yellow violet	-	S2	Oconee, Pickens	mesic forests
Viola tripartita var. *glaberrima*	smooth three-parted violet	-	S1	Oconee	rich woods[f]
Viola tripartita var. *tripartita*	three-parted violet	-	S3	Oconee, Pickens	rich woods[f]
Waldsteinia lobata	Piedmont strawberry	-	S3	Oconee	forests, streambanks
Xerophyllum asphodeloides	eastern turkeybeard	-	S2	Oconee, Pickens	dry ridges and slopes
Communities					
basic forest	-	-	S2	Oconee	-
pine – oak heath	-	-	S3	Oconee, Pickens	-

Source: Species and Communities Known to Occur Within 15 Miles of Keowee Site October 31, 2012 (SCDNR 2012b)

(a) The list of species was screened to exclude those likely to occur only in the Blue Ridge Mountains ecoregion.
(b) Federal status: E = endangered, T = threatened, C = candidate (FWS 2012a).
(c) State rank: S1 = critically imperiled, S2 = imperiled, S3 = vulnerable, S4 = apparently secure, ? = uncertain (inexact or uncertain rank used as a qualifier), S#S# = a numeric rank range used to indicate uncertainty about the exact status of the element, SNR = unranked. State protection status: SE = state endangered, ST = state threatened (SCDNR 2012b).
(d) NatureServe Explorer (2010) for animals and Weakley (2010) for plants, unless otherwise indicated.
(e) Kaufman (2000).
(f) Gleason and Cronquist (1991).

Some of the State-ranked animal species also have been assigned a State protection status as threatened or endangered. Federally listed species were not similarly screened and all are listed in Table 9-12. Table 9-12 also lists species habitat affinities.

Of the 64 taxa listed in Table 9-12, three are Federally listed as endangered and one is a candidate for listing as threatened or endangered. The mountain sweet pitcher-plant (*Sarracenia rubra* ssp. *jonesii*) is considered endangered and inhabits bogs and cataract seeps in the mountains and in some areas in the foothills of the Piedmont, but is not known to occur near the Keowee site or the site of the cooling-water reservoir (NRC 1999b). The black-spored quillwort (*Isoetes melanospora*) is considered endangered and occupies shallow, flat-bottomed, temporary pools that form in depressions on granite outcrops that contain at least 2 cm of soil (NatureServe Explorer 2010). The smooth coneflower (*Echinacea laevigata*) is considered endangered and formerly inhabited prairie-like or post oak–blackjack oak (*Quercus stellata – Q. marilandica*) savannas maintained by fire, but now is known from open woods, cedar barrens, roadsides, dry limestone bluffs, utility corridors, and other open habitats (FWS 1995). The smooth coneflower has been reported to occur approximately 5 to 6 mi northeast of the Keowee site (NRC 1999b). Georgia aster, a Federal candidate species, also is a relict species of the post oak savannah-prairie communities, and now occupies a variety of dry habitats adjacent to roads; along woodland borders; in dry, rocky woods; and within utility corridors (Duke 2009c; FWS 2010a). None of these plant species is known to occur within or near the Keowee site or the site of the cooling-water reservoir.

Plant and animal surveys of the land within a 1-mi radius of the center of the Oconee site were conducted in 1998. This area included about half of the Keowee site and none of the site of the supplemental cooling-water reservoir. Surveys identified no important animal or plant species within the Keowee portion of the survey area (Duke Energy 1998). One State-ranked plant species has been documented within the footprint of the cooling-water reservoir: nestronia (*Nestronia umbellula*) (Table 9-12). Two State-ranked plant species were documented in the vicinity of the railroad spur: soft groovebur (*Agrimonia pubescens*) and nodding onion (*Allium cernuum*) (Table 9-12). Four State-ranked plant species have been documented in the vicinity of Lake Keowee: nestronia, three-parted violet (*Viola tripartita* var. *tripartita*), drooping sedge (*Carex prasina*), and Allegheny-spurge (*Pachysandra procumbens*) (Table 9-12) (Duke 2010g). These species could potentially occur within the footprint of the Keowee site or the site of the cooling-water reservoir.

Nestronia is a shrub that inhabits moist to dry woods in the Piedmont ecoregion. It is parasitic on the roots of both pine and deciduous trees (Gleason and Cronquist 1991) and is considered vulnerable in South Carolina (NatureServe Explorer 2010; SCDNR 2012b). Soft groovebur inhabits dry to moist forests and woodlands (Weakley 2010) and is considered critically imperiled in South Carolina (NatureServe Explorer 2010; SCDNR 2012b). Nodding onion occurs in open woodlands or around rock outcrops (Weakley 2010) and is considered imperiled in South Carolina (NatureServe Explorer 2010; SCDNR 2012b). Three-parted violet inhabits rich woods (Gleason and Cronquist 1991; Weakley 2010) and lacks sufficient documentation in South Carolina (NatureServe Explorer 2010; SCDNR 2012b). There are two varieties in the State: the smooth three-parted violet (*V. tripartita* var. *glaberrima*), which is considered critically imperiled; and the three-parted violet, which is considered vulnerable (Table 9-12) (SCDNR 2012b). Drooping sedge occurs in deciduous forests, often along streams or in seepage areas, fens, or springs (Ball et al. 2002); it is considered imperiled in South Carolina (NatureServe Explorer 2010; SCDNR 2012b). Allegheny-spurge is a groundcover species that occurs in woodlands (NatureServe Explorer 2010) and is considered imperiled in South Carolina (NatureServe Explorer 2010; SCDNR2012b).

Building Impacts

Building activities for two nuclear units on the Keowee site would remove about 297 ac of high-quality wooded habitat (Duke 2010g) and disturb about 3.5 ac of wetlands (Duke 2010g, 2011h). Site preparation for the railroad spur, transmission line, and cooling-water pipeline would remove approximately 60 ac of high-quality wooded habitat (Duke 2010g) and would disturb about 3 ac of wetlands (Duke 2010g, 2011h). Site preparation and inundation of the supplemental cooling-water reservoir would remove about 1000 ac of high-quality wooded habitat (Duke 2010g) and about 19 ac of wetlands (Duke 2010g, 2011h). Site preparation at the Keowee site and the ancillary facilities, and site preparation and inundation of the cooling-water reservoir, would affect 149,000 linear ft (approximately 28 mi) of streams (Duke 2010g, 2011h). The riparian corridors of about 127,000 linear ft (approximately 24 mi) of these streams would be permanently inundated by creation of the reservoir. It is uncertain to what extent riparian corridors would be affected along the other 22,000 linear ft (approximately 4 mi) of streams associated with the Keowee site and ancillary facilities, this would depend on the need to clear riparian vegetation (e.g., for transmission-line clearance), and the length of stream that would be so affected has not been determined (Duke 2011h). The overall impact of reservoir development on terrestrial resources would be noticeable and permanent.

One plant species ranked by the State as critically imperiled, three plant species ranked as imperiled, one plant species ranked as vulnerable, and two plant species varieties (one ranked as critically imperiled and the other ranked as vulnerable) could be affected by development of the Keowee site and associated facilities (Duke 2010g). Other Federally listed and State-ranked species that may be present in the project footprint (Table 9-12) could also potentially be affected. Impacts on wildlife at the Keowee site would be noticeable and similar to those described for the Lee Nuclear Station site in Section 4.3.1.

Operational Impacts

Impacts on terrestrial ecological resources from operation of two new nuclear units at the Keowee site would be minor and similar to those for the Lee Nuclear Station site as described in Section 5.3.1. There may be minor differences in operational impacts because of factors such as climate, topography, and elevation.

Cumulative Impacts

Overlaying the historic impacts in the Piedmont ecoregion discussed in the Site Description above are the current projects listed in Table 9-10. Projects located within the geographic area of interest include Oconee Nuclear Station Units 1, 2, and 3; two hydroelectric plants; an area of U.S. Department of Transportation (USDOT) highway infrastructure improvements; a fabric mill; a smelting plant; a motor products manufacturing facility; several wastewater-treatment facilities; areas of Federal and other grants to build wastewater-treatment and drinking-water facilities and green infrastructure; Jocassee Gorges Management Area; and Mile Creek County Park. The development of most of these projects has further reduced, fragmented, and degraded natural forests and wetland and riparian habitat and decreased habitat connectivity. In contrast, the Jocassee Gorges Management Area and Mile Creek County Park help conserve terrestrial resources in perpetuity. Reasonably foreseeable projects and land uses within the geographic area of interest that would affect terrestrial resources include ongoing silviculture, farming, and agricultural development, and residential and some limited commercial development.

Summary

Impacts on terrestrial ecology resources are estimated based on the information provided by Duke and the review team's independent review. Site preparation and inundation of the cooling-water reservoir, and site preparation and development of the Keowee site, new transmission-line corridor, water-pipeline corridor, and a railroad spur would affect a total of about 1357 ac of high-quality forest habitat, about 26 ac of wetlands, and about 28 mi of riparian corridor. The overall impact of these activities on habitat and wildlife would be noticeable and permanent, particularly in the watershed containing the reservoir. There are 64 Federally listed or State-ranked terrestrial taxa and 2 communities that potentially occur at the Keowee site and associated facilities that may be affected. There are past, present, and future activities in the geographic area of interest that have affected and would continue to significantly affect habitat and wildlife in ways similar to site preparation and development for the above facilities (i.e., silviculture, farming, and agricultural development, and residential and some limited commercial development).

The review team concludes that the cumulative impacts from past, present, and reasonably foreseeable future actions, including two new nuclear units at the Keowee site and associated facilities, on baseline conditions for terrestrial ecological resources in the geographic area of interest would be MODERATE. The incremental contribution to these impacts from building and operating two new nuclear units at the Keowee site would be significant. The impact could be greater if surveys revealed that Federally listed species are present.

9.3.4.4 Aquatic Resources

The following analysis includes impacts from building and operating the proposed new facilities on aquatic ecology resources at the Keowee site. The analysis also considers past, present, and reasonably foreseeable future actions that affect the aquatic ecological resources, including other Federal and non-Federal projects and the projects listed in Table 9-10. For the analysis of aquatic ecological impacts at the Keowee site, the geographic area of interest includes Lake Keowee and the Seneca River approximately 6 mi downstream to its junction with Lake Hartwell. This geographic region is considered the most likely to show impacts on water quality relative to the water-quality criteria for aquatic biota.

In developing this EIS, the review team relied upon reconnaissance-level information to perform the alternative site evaluation in accordance with ESRP 9.3 (NRC 2000a). Reconnaissance-level information is data that are readily available from agencies and other public sources such as scientific literature, books, and Internet websites. It also can include information obtained through site visits. To identify aquatic resources at the Keowee site, the review team relied primarily on the following information:

- Oconee Nuclear Station Final Environmental Report (Duke Energy 1998) and Environmental Impact Statement for license renewal (NRC 1999b)
- Lee Nuclear Station Joint Application for Activities Affecting Waters of the United States submitted by Duke (2011h) to the USACE
- a tour of the Keowee alternative site in April 2008 (NRC 2008d) and a tour of the Keowee alternative site and supplemental cooling-water reservoir site in August 2010 (NRC 2010c)
- responses to RAIs provided by Duke (2010g, 2010l)
- FWS Endangered Species Program database for South Carolina (FWS 2012a) and South Carolina Natural Heritage Program (SCDNR 2012j, 2012n, 2012o) county record searches
- correspondence regarding species occurrence from the SCDNR (SCDNR 2012b).

Site Description

The Keowee site is located immediately south of the Oconee Nuclear Station in the Savannah River drainage basin, and the two stations would have separate cooling-water intake and discharge structures. Lake Keowee and the Seneca River are the most important aquatic resources near the Keowee site.

The staff visited the Keowee site in April 2008 (NRC 2008d) and August 2010 (NRC 2010c). Although Lake Keowee is affected by housing developments, much of the shoreline is bordered by vegetation. There are areas where the shoreline is scoured and exposed due at least in part to fluctuating water levels.

Recreationally Important Species

Common and popular sport fish in Lake Keowee include Bluegill (*Lepomis macrochirus*), Redbreast Sunfish (*L. auritus*), Redear Sunfish (*L. microlophus*), Pumpkinseed (*L. gibbosus*), Black Crappie (*Pomoxis nigromaculatus*), White Crappie (*P. annularis*), Largemouth Bass, Striped Bass, and hybrid bass (White Bass *Morone chrysops* x Striped Bass *M. saxatilis*). Because of the low nutrient content of the water, Lake Keowee has a relatively low standing crop of fish. Data on angler effort and harvest rates collected over a period from 1974 to 1993 (Barwick et al. 1995) indicated that Largemouth Bass were the most important sport fish in the reservoir and that sunfish (*Lepomis* spp., including Bluegill) and crappie were the only other species that contributed in a significant way to the reservoir's sport fishery. Striped Bass are another popular sport fish that can be found in the Seneca River.

Non-Native and Nuisance Species

Algae have never been present in nuisance concentrations in Lake Keowee (NRC 1999b). However, South Carolina reports that at least one aquatic plant species (*Hydrilla verticillata*) and several invasive fish species may be present. The fish include the Spotted Bass, White Perch (*Morone americana*), and Green Sunfish (*Lepomis cyanellus*) (SCDNR 2008c).

Federally Listed and State-Ranked Species

Duke provided no new field survey information for the Keowee site beyond its partial characterization in 1998 for the Oconee Nuclear Station license renewal ER (Duke Energy 1998). During that survey no Federally listed species or State-listed aquatic species were found within a 1-mi radius of the Oconee Nuclear Station. The review team is unaware of any field surveys performed at the sites of the proposed cooling-water reservoir, the transmission-line corridor, water-pipeline corridor, or railroad-spur corridor. The presence/absence of listed species in the project footprint cannot be ascertained without field surveys.

A recent review of the Federally listed and State-ranked aquatic species that may occur in Anderson, Oconee, and Pickens Counties near the Keowee site was performed by the review team. No Federally listed aquatic species were identified (FWS 2012a). State-ranked species included three fish, the Carolina Fantail Darter (*Etheostoma brevispinum*), Banded Darter (*E. zonale*), and Blacknose Dace (*Rhinichthys obtusus*); Carlson's polycentropus caddisfly (*Polycentropus carlsoni*); and eel-grass (*Vallisneria americana*) (SCDNR 2012j, n, o). In addition, although not State-ranked, the Carolina Darter is assigned a State protection status of threatened (SCDNR 2012n). The State ranking (in addition to the Federal listing) provides the only common basis for comparison of numbers and important aquatic species among the proposed and alternative sites located in North Carolina and South Carolina. Of the species listed in Table 9-13, the Carolina Darter, Banded Darter, and Carlson's polycentropus caddisfly have been positively identified by the State as occurring within 15 mi of the Keowee site (SCDNR 2012b).

Table 9-13. Aquatic Federally Listed Species and State-Ranked Species in Anderson, Oconee, and Pickens Counties, South Carolina

Scientific Name	Common Name	Federal Status(a)	SC State Rank/ Protection Status(b)	Counties of Occurrence(c)
Fish				
Etheostoma brevispinum	Carolina Fantail Darter	---	S1/---	Pickens
Etheostoma collis	Carolina Darter	---	SNR/T	Anderson
Etheostoma zonale	Banded Darter	---	S1?/---	Oconee, Pickens
Rhinichthys obtusus	Blacknose Dace	---	S1/---	Oconee
Insect (with aquatic life stage)				
Polycentropus carlsoni	Carlson's polycentropus caddisfly	---	S1S3/---	Pickens
Aquatic plant				
Vallisneria americana	eel-grass		S1	Anderson

(a) Federal status: (FWS 2012a).
(b) State rank: S1 = critically imperiled, S2 = imperiled, S3 = vulnerable, S#S# = a numeric range rank used to indicate uncertainty about the exact status of the element, SNR = unranked; State protection status: T = threatened (SCDNR 2012j, n, o).
(c) Counties of Occurrence: SCDNR 2012j, n, o.

Carolina Darter

The Carolina Darter has a South Carolina state protection status of threatened and is designated as a species of high conservation priority by SCDNR (2005). This small (up to 6-cm long) fish is typically found in small upland creeks and rivulets in both wooded and pasture areas in pools or slow-moving runs and often among vegetation that includes brush and fallen tree limbs (NatureServe Explorer 2010). They are difficult to sample in such habitat. The Carolina Darter exists only in the Piedmont region from south-central Virginia through North Carolina and into north-central South Carolina, and natural heritage records exist for the species in Anderson County, South Carolina (SCDNR 2005; NatureServe Explorer 2010). Watershed distribution maps indicate the species is currently found in the Seneca/Savannah River Basin (NatureServe Explorer 2010). Because no recent surveys have been conducted specifically looking for Carolina Darters in the vicinity of the Keowee site, it is possible that the species could be present, and could potentially be affected by station building activities and/or operation.

Carolina Fantail Darter

Formerly known as the Fantail Darter (*Etheostoma flabellare*), the *E. flabellare brevispinum* subspecies was elevated to species level and is now known as *E. brevispinum* (Blanton and Schuster 2008). The Carolina Fantail Darter is ranked in South Carolina as an S1 species (critically imperiled) and is classified as a species of high priority on its Priority Conservation Species List (SCDNR 2005). The Carolina form of the Fantail Darter is endemic to the Piedmont and Blue Ridge sections of the Upper Pee Dee and Santee River drainages in the state (SCDNR 2005). This fish inhabits gravel riffles in small- to medium-sized rivers in strong currents and relies on rocky substrates for feeding and spawning. The Carolina form of the Fantail Darter is considered secure in North Carolina, but relatively little is known about its population size or trends in South Carolina (SCDNR 2005). It is not likely to be found in Lake Keowee but may inhabit portions of the Seneca River.

Banded Darter

The Banded Darter is a member of the family Percidae. It is ranked S1, critically imperiled, in South Carolina, and is given moderate conservation priority (SCDNR 2005). In South Carolina, the species is restricted to the Seneca River system in the upper Savannah River drainage. However, outside the state, the species has a wide distribution, extending from Minnesota to New York and south to northern Alabama and Georgia (SCDNR 2005). There have been no records of the Banded Darter from the Seneca River drainage since 1986, making it possible that the species has been extirpated from the state (SCDNR 2005). Although it is highly unlikely to be present in the vicinity of the Keowee alternative site, because no recent surveys have been conducted specifically looking for the Banded Darter in the vicinity of the Keowee site, it is possible that the species could be present and could potentially be affected by station building activities and/or operation.

Blacknose Dace

The Blacknose Dace is ranked S1, critically imperiled, in the State of South Carolina and is identified as a species of moderate conservation priority (SCDNR 2005). The Blacknose Dace is found in the upper Savannah River drainage in South Carolina, which includes Pickens County. It prefers small- to medium-sized creeks with cool waters, slow-to-rapid current, and a mixed substrate consisting of sand, gravel, and rock. Therefore, this species is not likely to inhabit Lake Keowee. Because much of this fish's habitat has been protected in the Mountain Bridge Wilderness Area at Jones Gap State Park in Marietta, South Carolina (more than 20 mi northeast of the Keowee site), the species is considered stable within its entire range, which stretches north to Canada (SCDNR 2005).

Carlson's Polycentropus Caddisfly

In South Carolina, this caddisfly species is only known from a few sites in the Upper Piedmont, including a Seneca River watershed site in Pickens County (NatureServe Explorer 2010). It is ranked S1S3 (Table 9-13, footnote [b]) in South Carolina. Because little is known about this species and no recent species-specific surveys have been conducted in the vicinity of the Keowee site, it is possible that the species could be present and could potentially be affected by station building and/or operating two new nuclear units at the Keowee site.

Eel-Grass

A member of the tape-grass family (Hydrocharitaceae), eel-grass is found in tidal freshwater marsh where the average annual salinity is less than 0.5 parts per thousand, as well as in clear lakes and in flowing waters of clear streams and small rivers (Nelson 1986; USACE 2012c). Not a true grass, eel-grass is a native submerged aquatic vegetation species distributed across much of the United States. The plants are considered a beneficial food source for waterfowl and are sometimes planted for wildlife and fish habitat (USACE 2012c). However, large colonies sometimes interfere with boating and fishing because the long, ribbon-like leaves can reach 3 ft in length and can fill narrow or shallow waterways (USACE 2012c). Eel-grass is State-ranked (S1, critically imperiled) in South Carolina and has been documented in Anderson County (SCDNR 2012n), but not within 15 mi of the Keowee site (SCDNR 2012b). Efforts to establish additional native eel-grass plants to combat the spread of non-native species such as *Hydrilla* have been undertaken in some parts of the State (SCDNR 2012q).

Critical Habitats

No critical habitat has been designated by FWS or NMFS in the vicinity of the Keowee site.

Building Impacts

Building impacts would likely include impacts on water quality from direct (e.g., dredging, shoreline excavation, clearing, impoundment, etc.) and indirect sources (e.g., stormwater runoff, sedimentation, etc.). Two new reactor units at the site would require cooling-water intake and discharge systems. The cooling-water intake structure for two new nuclear units at the Keowee site would be located on Lake Keowee. Duke did not provide details of the effluent discharge location. However, it is standard practice for power plants to design cooling-water intake and effluent discharge locations such that recirculation of discharged effluent to the intake does not occur. Operation of new facilities at the Keowee site would require one offsite supplemental cooling-water reservoir (1300 ac [Duke 2010g] with approximately 80,000 ac-ft of storage [Duke 2010l]) and ancillary facilities consisting of a railroad spur, a transmission line, and a cooling-water pipeline (Duke 2010g). The new site, reservoir, and ancillary facilities would affect up to 149,000 linear ft (approximately 28 mi) of streams, which includes conversion of 127,000 linear ft of stream from a lotic to lentic ecosystem for the supplemental cooling-water reservoir

(Duke 2010g). Building activities would also affect a total of 15 ac of open water (10 ac associated with the site, 2.3 ac associated with the reservoir, and 2.8 ac associated with ancillary features) (Duke 2011h). The impacts of building two new nuclear units and one new reservoir on the aquatic ecology of Lake Keowee and the affected tributaries would be clearly noticeable.

A new transmission-line corridor would be needed to connect the site to the transmission system, as described in Section 9.3.4.1. A railroad spur would also be installed to transport building materials to the site. Impacts on aquatic resources from the transmission lines and railroad-spur installation would be similar to those described for the proposed Lee Nuclear Station site in Section 4.3.2.

Operational Impacts

Because a closed-cycle cooling system and supplemental cooling-water reservoir are proposed for the Keowee site, operational impacts would be expected to be similar to those for the Lee Nuclear Station site, as described in Section 5.3.2.

Cumulative Impacts

Current actions in the vicinity that have present and future potential impacts on aquatic ecological resources include operation of several energy-production facilities in the Keowee-Toxaway complex; discharge of water by domestic and industrial NPDES permit holders; withdrawal of water for domestic and industrial purposes; the existence of nature preserves; and future urbanization of the area (Table 9-10).

The existing Oconee Nuclear Station is part of Duke’s integrated energy-producing area called the Keowee-Toxaway complex, which also includes a conventional hydroelectric facility and two pumped-storage hydroelectric facilities that use Lake Jocassee and the Bad Creek Reservoir. Lakes Keowee and Jocassee were both installed between 1968 and 1974 as part of the overall project. The Oconee Nuclear Station is situated on the south-central shore of Lake Keowee. These facilities have greatly modified aquatic habitat in the region and will continue to affect aquatic resources while they are operational.

During license renewal for the Oconee Nuclear Station, the NRC staff determined that entrainment and impingement impacts on fish and shellfish have been minor at the Oconee Nuclear Station (NRC 1999b). Operation of the existing Oconee facility, including thermal and chemical discharge, has not resulted in an evident impact on the recreational fish species of Lake Keowee or the Seneca River. In addition to the Oconee Nuclear Station NPDES-permitted discharge activity to the Keowee River, there is at least one minor NPDES permit currently authorized for discharge to Lake Keowee (EPA 2011m).

The Jocassee Gorges Management Area and Mile Creek County Park preserve some of the headwaters of the region near Lake Jocassee and a portion of Lake Keowee shoreline, thereby limiting the potential for future urbanization in those areas. Reasonably foreseeable projects and water uses within the geographic area of interest that would affect aquatic resources include building and operating new drinking-water facilities and water-treatment plants, farming and agricultural development, and residential and possibly some limited commercial development.

Summary

Impacts on aquatic ecology resources are estimated based on the information provided by Duke and the review team's independent review. Site preparation and inundation of the supplemental cooling-water reservoir, and site preparation and development of the Keowee site, new transmission-line corridor, water-pipeline corridor, and a railroad-spur corridor would affect about 149,000 linear ft (approximately 28 mi) of stream habitat and the associated aquatic species. The overall impact of these activities on aquatic habitat and biota would be noticeable and permanent, particularly in the tributary that would be impounded to create the supplemental cooling-water reservoir.

Five State-ranked aquatic species and one State-listed aquatic species potentially occur at the Keowee site and associated facilities that may be affected. Three of these species have been positively identified as occurring within 15 mi of the Keowee site (SCDNR 2012b).

There are past, present, and future activities in the geographic area of interest that have affected and would continue to significantly affect aquatic resources in ways similar to site preparation and development for the above facilities (i.e., surface and groundwater consumption, thermal and chemical discharges to waterbodies, farming, and agricultural development, and residential and some limited commercial development).

The review team concludes that the cumulative impacts from past, present, and reasonably foreseeable future actions, including two new nuclear units at the Keowee site and associated facilities, on baseline conditions for aquatic ecological resources in the geographic area of interest would be MODERATE. The incremental contribution to these impacts from building and operating two new nuclear units at the Keowee site would be significant. The impact could be greater if surveys reveal that Federally listed species are present.

9.3.4.5 Socioeconomics

For the analysis of socioeconomic impacts at the Keowee site, the geographic area of interest is considered to be the 50-mi region centered on the Keowee site with special consideration of the two-county area of Oconee and Pickens Counties, where the review team expects socioeconomic impacts to be the greatest. In evaluating the socioeconomic impacts of building and operations at the Keowee site in Oconee County, South Carolina, the review team undertook a reconnaissance survey of the region using readily obtainable data from the ER; the alternative site audit; and Federal, State, and local government agencies. The cumulative impacts analysis also considers other past, present, and reasonably foreseeable future actions that affect the same environmental resources, including other Federal and non-Federal projects and the projects listed in Table 9-10.

Socioeconomic impacts span the issues of physical impacts, demography, economic conditions and taxes, and infrastructure and community services. The impacts of building and operating the new units are discussed below.

Physical Impacts

Many physical impacts of building and operation would be similar regardless of the site. Building activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, shock from blasting, and dust emissions. The use of public roadways, railways, and waterways would be necessary to transport materials and equipment. Offsite areas that would support building activities (e.g., borrow pits, quarries, and disposal sites) would be expected to be already permitted and operational. Offsite activities would include the development of a supplemental pond, cooling-water pipeline, railroad spur, and new transmission-line corridor. No residential developments exist within the site boundaries but the site vicinity is experiencing low residential growth. The intake structure would be built in an area with high residential growth.

Potential impacts from station operation include noise, odors, exhausts, thermal emissions, and aesthetics. New units would produce noise from the operation of pumps, cooling towers, transformers, turbines, generators, and switchyard equipment. In addition, traffic at the site would be a source of noise. The review team assumed that the same standard noise protection and abatement procedures used for the Lee Nuclear Station site would be used to control noise at the Keowee site. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to the Keowee site.

The new units at the Keowee site would likely have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that air emissions comply with applicable regulations. In addition, the generators would be operated on a limited, short-term basis. During normal plant operation, new units would not use a significant quantity of chemicals that could generate odors that exceed odor detection threshold values. Good access roads and appropriate speed limits would minimize the dust generated by the commuting workforce.

The visual aesthetics of the area have already been altered by the Oconee Nuclear Station adjacent to the Keowee site; however, development of the intake structure in the middle of a high-level residential area would affect local residents. Building other ancillary facilities and the reservoir would affect aesthetics in the area. The review team concludes that the aesthetic impacts of building two units and its associated facilities at the Keowee site would be noticeable but not destabilizing. Once the reservoir is completed, aesthetic impacts from operation would be minimal.

Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that other physical impacts of building and operating two new nuclear units at the Keowee site would be minimal except for a noticeable physical impact on aesthetics during the building phase.

Demography

The Keowee site is located in Oconee County, South Carolina (population 73,035) near the towns of Seneca (population 8024) and Clemson (population 13,596) to the southwest and southeast of the site, respectively. Clemson is located in Pickens County, South Carolina (population 117,823). During the summer months, the population in the vicinity increases due to people with summer homes along nearby lakes. The City of Anderson (population 26,566) is southeast of the site. Greenville, South Carolina (population 57,821), is also included in the 50-mi region (USCB 2010e).

Based on the proposed site location, the regional population distribution, and U.S. Census Bureau Journey to Work Data (USCB 2000h), the review team expects the in-migrating population would reside in the two-county area of Oconee and Pickens Counties. In 1999 during the operating license renewal of the Oconee Nuclear Station, adjacent to the Keowee site, approximately 79 percent of the workforce lived in Oconee County (891 employees) and Pickens County (515 employees) (NRC 1999b). The review team realizes that workers may choose to live in other counties within the 50-mi region but given the small number of workers and the large population base the review team expects impacts on other counties to be *de minimis.* Therefore, Oconee and Pickens Counties compose the economic impact area and are the focus of the following analysis.

At the peak of the nuclear power station development, Duke expects the workforce onsite to be approximately 4613 workers. Because the Keowee site is similar to the proposed Lee Nuclear Station site in geography and urbanization, development of the proposed new units on the Keowee site would have similar socioeconomic impacts in most respects to building the two units on the Lee Nuclear Station site. Based on the analysis of project impacts presented in Section 4.4.2, of the 4613 peak workers approximately 3191 workers would in-migrate into the region with some workers bringing a family for a total in-migrating population of 4516 people. Considering that the maximum estimate of in-migrating population is less than 1 percent of the existing regional population, the review team expects the demographic impacts of building two units on the Keowee site would be minimal. Once the plant is operational, Duke estimates the workforce to be about 957 workers with an estimated 345 migrating into the region, similar to the Lee Nuclear Station site. Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that the demographic impacts of building and operating two new nuclear units at the Keowee site would be minimal.

Economic Impacts on the Community

Economy

The local labor force is dominated by manufacturing, government, and retail trade. Some of the top manufacturing employers are Duke (Oconee Nuclear Station), Itron (electronic measuring devices), Schneider Electric (motor control centers), and Timken U.S. Corp. (thrust bearings). Agriculture represents 19 percent (78,349 ac) of total Oconee County land area (Duke 2009c). Oconee County's 2009 total labor force was 31,884 with an unemployment rate of 13.7 percent. Pickens County's 2009 labor force was 58,194 with an unemployment rate of 10.8 percent. The 2006 unemployment rates for Oconee and Pickens County were 8.8 and 6.2 percent, respectively (BLS 2011a). The significant increase in unemployment rates between 2006 and 2009 is attributed to the recent economic downturn afflicting much of the country.

The wages and salaries of the project workforce would have a multiplier effect that would result in increases in business activity, particularly in the retail and service sectors. This multiplier effect would have a positive impact on the business community and could provide opportunities for new businesses and increased employment opportunities for local residents. The review team expects that most indirect jobs created in the region would be allocated to residents in the region. Expenditures made by the indirect workforce would also strengthen the regional economy. Because the review team assumes the economic impacts of the proposed site (in Section 4.4.3.1 and Section 5.4.3.1) also apply to the Keowee site, the review team concludes the impact of these new indirect jobs would constitute a small percentage of the total number of jobs in Oconee and Pickens Counties and would have a minimal and beneficial economic impact.

Taxes

If the proposed nuclear plant were located at the Keowee site, Duke would likely enter into a fee-in-lieu of taxes agreement with Oconee County as allowed by South Carolina State law. This agreement would be similar to the one discussed in Section 5.4.3.2. Without a fee-in-lieu agreement, Duke would pay taxes under the governance of South Carolina State law. This agreement would not go into effect until operations at the Keowee site have commenced. During the construction phase, Duke would continue to pay taxes on the land itself. In 2010, Oconee County property tax revenues were $36 million of the County's $54 million total revenues (Oconee County 2010). Based on the agreement Duke has with Cherokee County in regard to the Lee Nuclear Station, which has an assessment value of 2 percent for the fee-in-lieu-of-taxes payments during the first 20 years, Duke estimates Lee Nuclear Station annual payments would be $11.8 million over 40 years of the license period. If Duke entered into a similar agreement for the Keowee site, the tax payments would increase Oconee County property tax revenues substantially. Total economic and tax impacts during building activities would have a minimal beneficial impact. The total fee-in-lieu-of-tax payment would be expected to be substantial and beneficial during operations in Oconee County and minimal for the rest of the region.

Infrastructure and Community Services

Traffic

Oconee County is served by I-85 at its southeast corner, plus US-76 and US-123 and South Carolina highway 28 (SC 28) and Scenic SC 11. The Keowee site is accessible from Keowee River Road, a two-lane highway (SC 37). This highway provides service to the site conveniently from four main directions (Duke 2009c). A railroad spur would need to be built for the transport of materials and equipment to the site, and there is residential area near the site (Duke 2009c). One road would require widening, another would be relocated, and a new access road would be developed (Duke 2009c). Given the large number of additional vehicles added to the roads during peak construction, the review team expects traffic-related impacts from building the plant at the Keowee site would be noticeable on roads near the site. The review team expects traffic-related impacts from operations of a nuclear power station on the Keowee site to be minimal.

Housing

Based on the analysis in Section 4.4.2, approximately 3191 workers would migrate into the region during the peak employment period of the building phase. Later, approximately 345 operations workers would migrate into the region by the time the plant becomes operational. The 2006–2010 ACS estimate for Oconee County indicated a total housing stock of 37,713 units, of which 7803 were vacant (USCB 2010e). Pickens County had 50,854 housing units, of which approximately 6806 were vacant (USCB 2010e). The review team expects that the in-migrating construction workforce could be absorbed fairly easily into the existing housing stock in the region and the impact would be minimal.

Based on the information provided by Duke and the review team’s independent evaluation, the review team concludes that traffic-related and housing impacts of building two new nuclear units at the Keowee site would be minor across the region with the exception of a noticeable traffic-related impact on roads near the site. Because of the much lower number of operations-related workers relative to workers during the building phase, the review team determined traffic-related and housing impacts from operations would be minimal.

Recreation

Recreational activities near the Keowee site are plentiful. Oconee County is in the foothills of the Appalachian Mountains and includes rivers, lakes, forest, and waterfalls. Oconee State

Park is 5 mi to the west, Keowee-Toxaway State Natural Area is 10 mi to the north, and Lake Keowee is 1 mi from the site. Keowee Lake hosts permanent and vacation residences, campgrounds, boat launches, marinas, and golf courses. During the summer months, the population within 10 mi of the site exceeds 25,000 people due to those who summer on Lake Keowee and Lake Hartwell (Duke 2009c). The supplemental reservoir would not be available for public recreation at any of the alternative sites or the proposed site. Duke has not indicated that recreational activities on Lake Keowee would be limited during building or operation of a nuclear project. Other recreational areas are far enough offsite not to be affected. Therefore, the review team expects impacts on recreation would be minimal for both building and operating two new nuclear units at the Keowee site.

Public Services

The influx of construction workers and plant operations staff settling in the region could affect local municipal water and water-treatment facilities, police, fire, medical, and other social services in the area. Oconee County has three water suppliers for a total of 18.9 Mgd and a utilization of 9.9 Mgd. The only wastewater-treatment plant in the county has a 7.8 Mgd capacity and a current utilization of 3.2 Mgd (Upstate Alliance 2009a). There is currently excess capacity in these systems sufficient to accommodate a new nuclear plant and the in-migration of workers and their families. The impact on public services would depend on the infrastructure that is developed on the site as well as the location in which the in-migrating workforce chooses to live. The in-migrating workers would represent a small portion of the total populations of Oconee and Pickens Counties and the review team expects they would have a minimal impact on public services.

Education

Oconee County has 19 schools with an overall kindergarten through 12th grade enrollment for the 2010–2011 school year of 10,606 students (NCES 2013). Pickens County has 25 schools in the county's district with a 2010–2011 student enrollment of 16,319. The review team expects, based upon the same underlying assumptions that governed the analysis for the proposed Lee Nuclear Station site, that approximately 400 students would move into the two-county area during the peak employment period for building activities. Assuming equal distribution of those students between counties, 200 additional students in each school district would represent a less than 5 percent increase in the student body population. Therefore, the review team determined building a nuclear facility on the Keowee site would have a minimal impact on education, and that the much smaller operations workforce would also have a minimal impact on education. Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that public services and education impacts of building and operating two new nuclear units at the Keowee site would be minor.

Summary of Building and Operation Impacts

Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Social and economic impacts span issues of demographics, economy, taxes, infrastructure, and community services. In summary, based on information provided by Duke and the review team's independent evaluation, the review team concludes that the adverse cumulative impacts on socioeconomics of building and operating a new nuclear plant at the Keowee site on socioeconomics would be minor for most of the region but would be noticeable, but not destabilizing, in terms of traffic-related and aesthetics impacts during peak project employment. During operations, these impacts are expected to be minimal. The impacts on the Oconee County tax base during operations likely would be substantial and beneficial; however, only minor beneficial tax impacts would result in the rest of the region.

Cumulative Impacts

The projects identified in Table 9-10, particularly the future urbanization of the region, have contributed or would contribute to the demographics, economic climate, and community infrastructure of the region and generally result in increased urbanization and industrialization. Because the projects within the review area identified in Table 9-10 would be consistent with applicable land-use plans and control policies, the review team considers the cumulative socioeconomic impacts from the projects to be minimal.

For the analysis of socioeconomic impacts at the Keowee site, the geographic area of interest is considered to be the 50-mi region centered on the Keowee site, with special consideration of Oconee and Pickens Counties, where the review team expects socioeconomic impacts to be the greatest.

The Keowee site is located in eastern Oconee County on the Oconee and Pickens County border adjacent to the existing Oconee Nuclear Station operated by Duke. The employment in the area near the Keowee site is a mixture of manufacturing, government, and retail trade with Duke being the largest employer with its Oconee Nuclear Station. The majority of the Oconee Nuclear Station's workforce lives in Oconee and Pickens Counties. The nearest towns are Seneca (population 8024) located to the southwest and Clemson (population 13,596) (USCB 2010e)located southeast in Pickens County. The large metropolitan area of Greenville is located east of the Keowee site.

The cumulative impact analysis considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative socioeconomic impacts on a given region, including other Federal and non-Federal projects and the projects listed in Table 9-10. Adverse cumulative impacts would include physical impacts (on workers and the local public, buildings, transportation, and aesthetics), demographics impacts, and impacts on local infrastructures and community services (transportation; recreation; housing; water and wastewater facilities; police, fire, and medical services; social services; and education).

Because most projects described in Table 9-10 do not include any significant reasonably foreseeable changes in socioeconomic impacts within 50 mi of the Keowee site, the review team determined there would be no significant additional cumulative socioeconomic impacts in the region from those activities. Regional planning efforts and associated demographic projections available at a reconnaissance level formed the basis for the review team's assessment of reasonably foreseeable future impacts. Any economic impacts associated with activities listed in Table 9-10 would have been considered as part of the socioeconomic baseline.

The cumulative economic impacts on the community would be beneficial and SMALL with the exception of Oconee County, which would see a LARGE and beneficial cumulative impact on taxes. The cumulative infrastructure and community services impacts are SMALL with the exception of a MODERATE and adverse cumulative impact on traffic near the Keowee site. The cumulative physical impacts are SMALL with the exception of a MODERATE and adverse impact on aesthetics near the site. Building and operating the proposed units at the Keowee site would be a significant contributor to the LARGE and beneficial economic impact on taxes in Oconee County and also to the MODERATE and adverse impact on infrastructure and community services related to traffic near the site and the MODERATE physical impact on aesthetics. The review team concludes that building two nuclear units at the Keowee site, in addition to other past, present, and reasonably foreseeable future projects would have SMALL cumulative impacts on demography.

9.3.4.6 Environmental Justice

The 2006–2010 ACS5-year population estimates at the census block group level were used for identifying minority and low-income populations in the region, employing the same sources and methodology explained in Section 2.6.1 for the proposed site, including a closer look at potential areas of interest using a series of health and physical considerations. There were a total of 949 census block groups within the 50-mi region (USCB 2011a, c). Approximately 96 of these census block groups were classified as aggregate minority populations of interest and 59 classified as African American populations of interest. There was 1 census block group with American Indian or Alaskan Native, 3 with Asian, 9 with "other" race, and 36 with Hispanic populations of interest. Oconee County had 7 African American, no Hispanic, and 1 aggregate minority census block groups with minority populations of interest. There were 84 census block groups classified as having low-income populations of interest in the 50-mi region, 4 of which were in Oconee County. There were 9 low-income census block groups adjacent to the site in Pickens County. The review team did not identify any Native American communities or other minority communities with the potential for a disproportionately high and adverse impact due to their unique characteristics or practices. Figure 9-6 shows the geographic locations of the

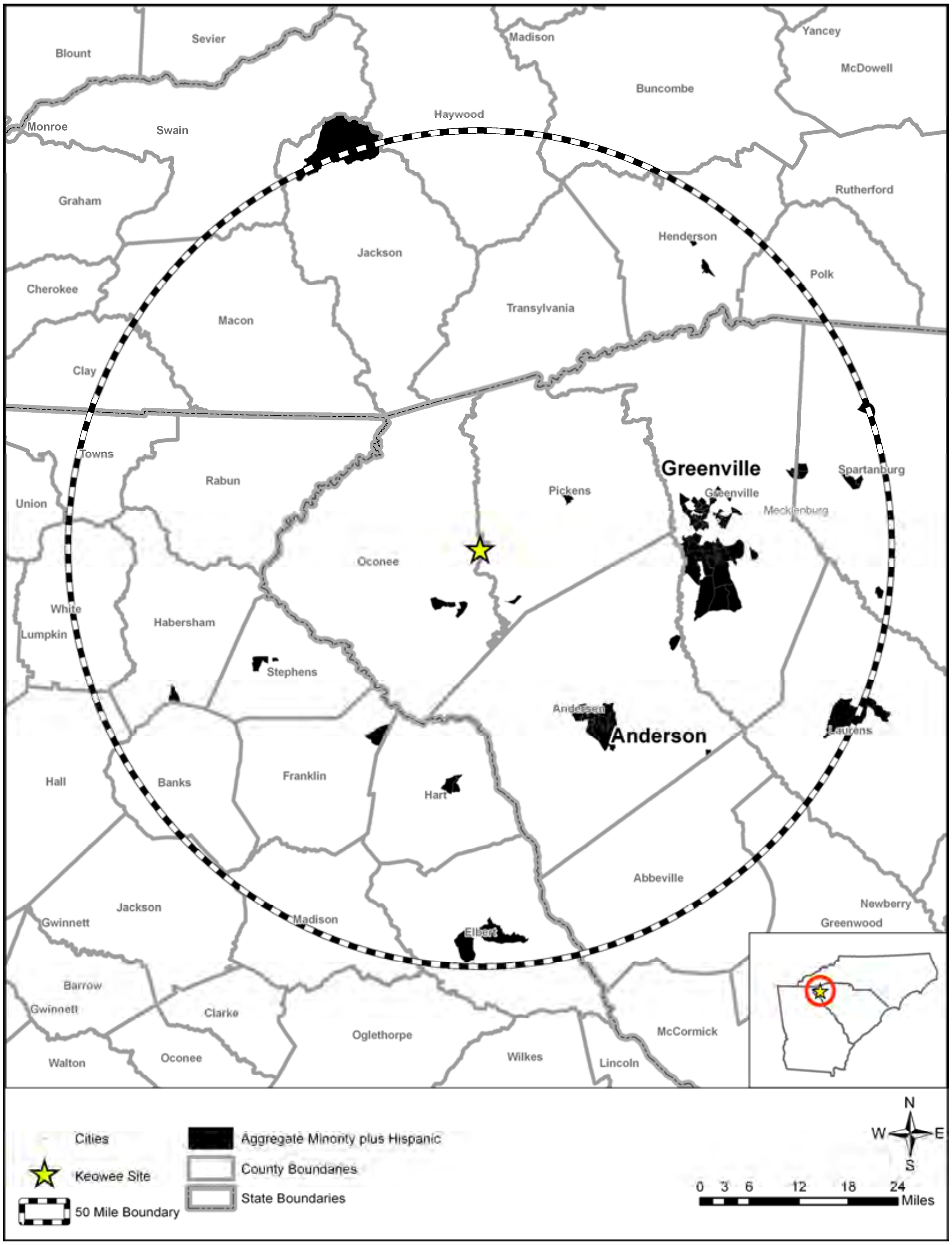

Figure 9-6. Aggregate Minority Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Keowee Site (USCB 2011a, c)

minority populations of interest within the 50-mi radius of the Keowee site, and Figure 9-7 shows the geographic locations of the low-income populations of interest within the 50-mi radius of the Keowee site.

Physical impacts from building activities (e.g., noise, fugitive dust, air emissions, and traffic) attenuate rapidly with distance, topography, and intervening vegetation. Therefore, the review team determined that, given the distance from the Keowee site to the nearest populations of interest, there would be no physical impacts with a disproportionately high and adverse effect on minority or low-income populations. For the same reasons, the review team determined the operation of the proposed project at the Keowee site is also unlikely to have a disproportionately high and adverse impact on minority or low-income populations. A supplemental water reservoir near the site would be needed, which would require acquiring private property from current residents and demolishing houses. New transmission-line corridors would be constructed to link the proposed units to the electric grid through the Oconee Station. The location of the pond is unknown but given the distance between the Keowee site and the location of minority populations of interest, impacts from the supplemental water pond and transmission-line corridors would not disproportionately and adversely affect minority populations. All land needed for the supplemental reservoir would be acquired similar to land acquisitions for Make-Up Pond C and all residents would be compensated. Though there are low-income populations of interest near the site, impacts from the supplemental pond and transmission-line corridors would not disproportionally and adversely affect low-income populations. See Sections 2.6, 4.5, and 5.5 for more information about environmental justice criteria and impacts.

In addition to environmental justice impacts from building and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to disproportionately high and adverse impacts on minority and low-income populations, including other Federal and non-Federal projects and the projects listed in Table 9-10. For the analysis of environmental justice impacts at the Keowee site, the geographic area of interest is considered to be the 50-mi region centered on the Keowee site.

The projects identified in Table 9-10 likely did not or would not contribute to environmental justice impacts of the region. Therefore, based on information provided by Duke and the review team's independent evaluation, the review team concludes there would not be any disproportionately high and adverse environmental justice cumulative impacts from the building and operation of two nuclear units at the Keowee site in addition to other past, present, and reasonably foreseeable future projects, and the cumulative environmental justice impacts would be SMALL.

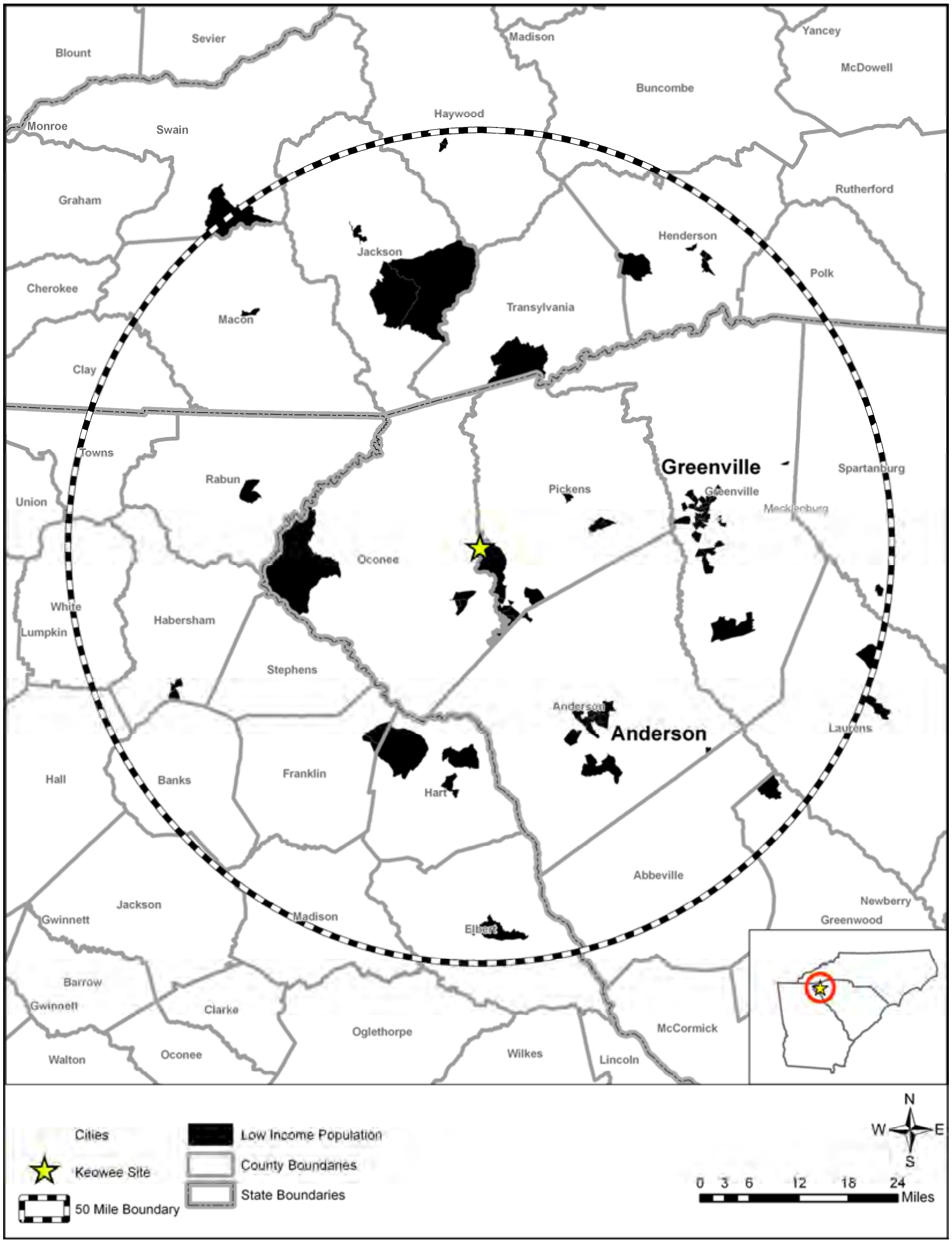

Figure 9-7. Low-Income Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Keowee Site (USCB 2011a, c)

9.3.4.7 Historic and Cultural Resources

The following analysis includes impacts on historic and cultural resources from building and operating two new nuclear generating units at the Keowee site in Oconee County, South Carolina. The analysis also considers other past, present, and reasonably foreseeable future actions that could cause cumulative impacts on cultural resources, including other Federal and non-Federal projects as listed in Table 9-10. For the analysis of cultural resources impacts at the Keowee site, the geographic area of interest is considered to be the onsite and offsite direct, physical and indirect, visual APEs associated with the proposed undertaking. This includes direct, physical APEs, defined as the onsite areas directly affected by site development and operation activities, as well as offsite areas such as railroad corridors, transmission lines, and new reservoirs. Indirect visual APEs are also included and defined generally as a 1-mi radius buffer around the proposed direct physical APEs, which encompasses the approximate maximum distance from which tall structures could be seen.

Reconnaissance activities in a cultural resources review have particular meaning. Typically such activities include preliminary field investigations to confirm the presence or absence of historic properties or cultural resources. However, in developing this EIS, the review team relied upon reconnaissance-level information to perform the alternative sites evaluation in accordance with ESRP 9.3 (NRC 2000a). In this context, reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through site visits. To identify historic and cultural resources at the Keowee site, the review team relied on the following information:

- the Oconee Nuclear Station ER for Operating License Renewal (Duke Energy Corp 1998), Lee Nuclear Station COL ER (Duke 2009c)
- an August 2010 informal tour of the Keowee site and visit to the South Carolina Room at the Anderson County Public Library in Anderson, South Carolina (NRC 2010c)
- archival records searches, National Register listings, and cultural resources probability assessments provided by Duke (Duke 2010t)
- the National Park Service's listing of properties on the National Register (NPS 2011b).

Site Description

Historically, the Keowee site and vicinity were largely undisturbed and contained intact archaeological resources associated with the past 10,000 years of human settlement. After European colonization, cotton cultivation became common on lands throughout the area. Only limited formal cultural resources investigations have been performed within the study area and no surveys have covered the direct physical APEs considered in this analysis (Duke 2010t).

Duke completed records searches at the South Carolina Department of Archives and History and the South Carolina Institute of Archaeology and Anthropology to assemble a list of previously recorded cultural resources and historic properties listed, or eligible for listing, on the National Register that could be affected if the Keowee site was selected for nuclear plant development (Duke 2010t). According to the search results, no cultural resources investigations have been completed within the onsite direct physical APE for the proposed new units or the associated reservoir and only limited investigations have been completed in the 1-mi buffer areas that constitute the indirect visual APEs for these developments. The limited surveys completed have resulted in the identification of seven cultural resources in the indirect visual APE for the new units, including one Native American mound site, five prehistoric archaeological sites, and one National Register-listed historic property. One historic cemetery has been previously recorded within the indirect visual APE for the proposed reservoir. Simple predictive modeling analyses completed by Duke (Duke 2010g) further indicate that approximately 70 percent of the lands included in the direct physical APE for the new units, 57 percent of the lands in the direct physical APE for the new reservoir, and 80 percent of the lands in the both of the associated indirect visual APEs exhibit high potential for additional cultural resources (i.e., well-drained soils, less than 15 percent slope, outside active floodplains or areas of seasonal or permanent inundation, largely undisturbed). The South Carolina SHPO has confirmed that no historic or cultural resources are known to exist at the nearby Oconee Nuclear Station (Duke Energy 1998).

Building and Operation Impacts

In the event that the Keowee site was chosen for the proposed project, the review team assumes that Duke would employ the same methods for identifying and assessing impacts on historic properties and cultural resources as those used during assessments at the Lee Nuclear Station site and associated developments. This would include field investigations and coordination with the South Carolina SHPO, interested American Indian Tribes, and the public that would be conducted before the initiation of any ground-disturbing activities. The results of these investigations and communications would be used in the site planning process to avoid or mitigate impacts and develop protective measures for any significant resources such as those already listed on the National Register. Duke is committed to this approach for the Lee Nuclear Station site and the review team assumes that Duke would employ the same methods at alternative sites, if chosen for the proposed project (Duke 2009c). Initial archival searches indicate that appropriate mitigations would need to be developed for potential visual or other indirect impacts from the new units on one National Register-eligible Native American mound site that may also have traditional cultural significance for American Indian Tribes and one National Register-listed historic architectural property. Additional important historic and cultural resources may also be discovered during new surveys in all APEs. As a result, impacts on cultural resources due to site development and building activities could be noticeable, but not destabilizing with appropriate mitigations implemented.

Impacts on historic and cultural resources from operation of the two new nuclear units at the Keowee site as well as parallel and related operations at offsite components such as the new reservoir, railroad line, and short transmission-line corridors would be possible. The review team assumes that Duke Energy's corporate policy for consideration of cultural resources and associated procedures in the event of an unanticipated discovery of cultural resources would apply to operations at the Keowee site and offsite areas (Duke 2009c). Further, the review team assumes that Duke would negotiate an agreement and associated cultural resources management plan for the Keowee site with the South Carolina SHPO, the USACE, and interested American Indian Tribes similar to efforts completed for the Lee Nuclear Station site (USACE et al. 2013). Interested American Indian Tribes may also be included in this consultation to address potential operational impacts on the Native American mound site located near the Keowee site. Under consistent application of Duke Energy's corporate policy for cultural resources and an agreement and cultural resources management plan specific to the Keowee site, impacts on cultural resources due to operations would be negligible.

Cumulative Impacts

The geographic area of interest for cumulative impacts on historic and cultural resources at the Keowee site corresponds to the onsite and offsite direct (physical) and indirect (visual) APEs defined for the site. As indicated in Table 9-10, past actions in the geographic area of interest that could have affected historic and cultural resources in a manner similar to those associated with the building and operation of the two new units and other project components include the building and operation of the Oconee Nuclear Station and the Keowee Hydroelectric Generating Plant. However, South Carolina SHPO records indicate that no historic or cultural resources are known at the Oconee plant (Duke Energy 1998), so these impacts were likely negligible. Sources at the Anderson County Library indicate that many significant historic and cultural resources were inundated by Lake Keowee and impacts may have also occurred as the associated hydroelectric plant was built (NRC 2010c). Table 9-10 also lists future projects that may similarly affect historic and cultural resources and contribute to cumulative impacts in the geographic area of interest, including transportation improvements associated with the South Carolina Strategic Corridor System Plan (SCDOT 2009b) and new developments associated with future urbanization in the region. These projects could affect historic and cultural resources through ground-disturbance or visual impacts on historic settings or architectural properties, but the inclusion of Federal funding in most of these efforts should ensure appropriate mitigation.

Summary

Cultural resources are non-renewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that the cumulative impacts from the past development of the Oconee Nuclear Station and Keowee Hydroelectric Generating Plant, future Federal transportation improvements and urbanization of the area, and the proposed building and operation of two new nuclear units on the Keowee site would be MODERATE. The incremental contribution of building and operating the two new units and associated plant components would be significant to these cumulative impacts given the National Register-listed historic property and potentially sensitive Native American mound site known to exist within the onsite indirect, visual APEs and the geographic area of interest.

9.3.4.8 Air Quality

The following impact analysis includes impacts on air quality from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that affect air quality, including other Federal and non-Federal projects listed in Table 9-10. The air-quality impacts related to building and operating a nuclear facility at the Keowee site would be similar to those at the Lee Nuclear Station site.

The Keowee site is located in Oconee County, South Carolina, which is part of the Greenville-Spartanburg Intrastate Air Quality Control Region (40 CFR 81.106). The geographic area of interest for this resource area is a 50-mi radius of the site, which includes Oconee County. Designations of attainment or nonattainment are made on a county-by-county basis. Oconee County is designated as being unclassified or in attainment for all criteria pollutants for which the NAAQSs have been established (40 CFR 81.341). Criteria pollutants include ozone, PM, CO, No_x, SO_2, and lead. The closest Class 1 Federal Area (i.e., Shining Rock Wilderness Area, North Carolina) is approximately 40 mi from the Keowee site and it would, therefore, not likely be affected by minor source emissions from the site. Class I areas are considered of special national or regional natural, scenic, recreational, or historic value and are afforded additional air quality protection.

As described in Section 4.7, emissions of criteria pollutants from building the two units are expected to be temporary and limited in magnitude. As discussed in Section 5.7, emissions of criteria pollutants from operations would be primarily from the intermittent use of standby diesel generators and pumps. Given the temporary air emissions from construction and intermittent air emissions from operation, and that Oconee County is currently designated as being unclassified or in attainment for criteria pollutants, the review team concludes the impacts from building and operating two new nuclear units on air quality would be minimal.

Cumulative impacts on air quality resources are estimated based on the information provided by Duke and the review team's independent evaluation. Of the projects listed in Table 9-10, only one project (the BASF Corporation) is considered a major source of NAAQS criteria air pollutants in Oconee County. Other past, present, and reasonably foreseeable activities exist in the geographic area of interest that could affect air quality resources. The impacts on criteria pollutants in Oconee County from emissions of effluents from the Keowee site, the nearby BASF project, and other projects and activities within 50 mi of the region would not be noticeable.

The greenhouse gas emissions from two nuclear units at the Keowee site would be the same as those analyzed in Chapters 4, 5, and 6 for the Lee Nuclear Station site. The cumulative impacts of greenhouse gas emissions related to nuclear power are discussed in Section 7.6. The impacts of the emissions are not sensitive to location of the source. Consequently, the conclusion in Sections 7.6—national and worldwide impacts of greenhouse gas emissions are noticeable but not destabilizing—is applicable to two AP1000 reactors located at the Keowee site.

The review team concludes that the cumulative impacts, including those from other past, present, and reasonably foreseeable future actions on air quality resources in the geographic area of interest would be SMALL for criteria pollutants and MODERATE for greenhouse gas emissions. The incremental contribution of impacts on air quality resources from building and operating two units at the Keowee site would not be significant. The incremental contribution of impacts on air quality resources from building and operating two units at the Keowee site would not be significant to the MODERATE air-quality impact from greenhouse gas emissions.

9.3.4.9 Nonradiological Health Impacts

The following analysis considers nonradiological health impacts from building and operating two new nuclear units at the Keowee alternative site. Impacts on nonradiological health at the Keowee site are estimated based on the information provided by Duke and the review team's independent evaluation. The analysis also includes past, present, and reasonably foreseeable future actions that could contribute to cumulative nonradiological health impacts on site workers and the public, including other Federal and non-Federal projects and the projects listed in Table 9-10. For the analysis of nonradiological health impacts at the Keowee site, the geographic area of interest is the immediate vicinity surrounding the Keowee site and the associated transmission-line corridors. This area of interest is based on the localized nature of nonradiological health impacts.

Building activities with the potential to affect the health of members of the public and workers at the Keowee site include exposure to dust, vehicle exhaust, and emissions from construction equipment; noise; occupational injuries; and the transport of construction materials and personnel to and from the site. The operation-related activities that may affect the health of members of the public and workers include exposure to etiological agents, noise, occupational injuries, EMFs, and impacts from the transport of workers to and from the site.

Building Impacts

Nonradiological health impacts on construction workers and members of the public from building two new nuclear units at the Keowee alternative site would be similar to those evaluated in Section 4.8 for the proposed Lee Nuclear Station site. Duke would comply with applicable Federal and State regulations on air quality and noise during the site preparation and building phase. The frequency of construction worker accidents would not be expected to be different from the frequency of accidents estimated for the Lee Nuclear Station site.

Section 4.8.3 concluded that the impacts on nonradiological health from the transport of construction workers and materials to and from the Lee Nuclear Station site would be minimal. The alternative sites range from about 31 percent lower impacts for the Middleton Shoals, South Carolina, site to 24 percent lower impacts for the Perkins, North Carolina, site than the estimated impacts for the Lee Nuclear Station site. These differences are due solely to differences in the average State-specific fatality rates used for construction workers. Transportation impacts on nonradiological health at the Keowee site would be minimal.

The Keowee site is located on a greenfield site directly adjacent to an existing, currently operational nuclear facility, surrounded by low- and high-density residential development (Duke 2009c). This site would require extensive grading to develop the proposed plant. Building activities, including associated transmission lines and the offsite supplemental cooling-water reservoir at the Keowee site, could create minimal to noticeable temporary air quality (i.e., fugitive dust and emissions from construction equipment) and transportation impacts in the vicinity of the site.

Operational Impacts

Nonradiological health impacts from operation of two new nuclear units on site workers and members of the public at the Keowee site would be similar to those evaluated in Section 5.8 for the proposed Lee Nuclear Station site. Occupational health impacts on workers (e.g., falls, electric shock or exposure to other hazards) at the Keowee site would likely be the same as those evaluated for workers at the Lee Nuclear Station site. Exposure to the public from waterborne etiological agents at the Keowee site would be similar to the types of exposures evaluated in Section 5.8.1, and the operation of the new nuclear units at the Keowee site would not likely lead to an increase in waterborne diseases in the vicinity due to thermal effluent limitations prescribed in the plant NPDES permit. Noise and EMF exposure would be monitored and controlled in accordance with applicable OSHA regulations. Effects of EMF on human health would be controlled and minimized by conformance with NESC criteria (IEEE 2012).

The impacts of transporting operations workers to and from the Keowee site range from about a 2 to 6 percent increase in traffic fatalities in the counties in which the alternative sites are located. These differences arise from differences in the average State-specific fatality rates used for operations workers and the county-specific baseline annual fatalities. Because these increases are small relative to the baseline traffic fatalities (i.e., before the new units are constructed) in the counties where Duke has proposed to build the new units, the review team concludes that the impacts of transporting construction materials and personnel to and from the alternative sites would be minimal. The review team concludes that impacts on site worker and public nonradiological health from the operation of the two nuclear units at the Keowee alternative site would be minimal.

Cumulative Impacts

Past actions in the geographic area of interest that have similarly affected nonradiological health include the development of the Oconee Nuclear Station Units 1, 2 and 3, located adjacent to the Keowee site and the development of the Keowee Hydroelectric Station, located approximately 1 mi north of the Keowee site. Development of these sites would have caused temporary, localized impacts on nonradiological health, but current operation of these facilities would not be expected to contribute significantly to cumulative impacts. The hydroelectric station and the nuclear stations would be expected to have very low rates of air emissions (associated with periodic use of backup generators), and cumulative transportation-related impacts associated with the operation of those facilities would be minimal (as discussed above). The Oconee Nuclear Station discharges thermal effluents to the Little River arm of Lake Keowee, but the station holds a current NPDES permit that imposes limitations on the temperature of the thermal discharge (NRC 1999b), and the Station’s contribution to cumulative impacts affecting the presence of thermophilic organisms would be minimal. There are no other major current projects in the geographic area of interest that would have a cumulative impact on nonradiological health in a similar way to the development of the Keowee site.

There are no proposed future actions that would affect nonradiological health in a way similar to development at the Keowee site. However, transmission-line creation and/or upgrading in the vicinity of the Keowee site and future urbanization would be expected to occur.

The review team is also aware of the potential climate changes that could affect human health—a recent compilation of the state of knowledge in this area (GCRP 2009) has been considered in the preparation of this EIS. Similar to the Lee Nuclear Station site, projected changes in the climate for the southeastern region of the United States during the life of the proposed nuclear station include a 2 to 3°F increase in average temperature and a decrease in precipitation in winter, spring, and summer, and an increase in precipitation in fall (GCRP 2009). This may result in a small, gradual increase in river water temperature, which may alter the presence of microorganisms and parasites in Lake Keowee. While the changes that are attributed to climate change in these studies (GCRP 2009) may not be insignificant on a national or global level, the review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change the incidence of waterborne diseases in the vicinity of the Keowee site. The review team concludes that the cumulative impacts on nonradiological health from building two new nuclear units, associated transmission lines, and an offsite reservoir at the Keowee site would be minimal.

Summary

Impacts on nonradiological health from building and operating two new units at the Keowee site are estimated based in the information provided by Duke and the review team's independent evaluation. The review team concludes that nonradiological health impacts on construction workers and the public resulting from the building of two new nuclear units, associated transmission lines, and offsite reservoir at the Keowee site would be minimal. The review team also expects that the occupational health impacts on members of the public and operations workers from two new nuclear units at the Keowee site would be minimal. Finally, the review team concludes that cumulative nonradiological health impacts from related past, present, and future actions in the geographic area of interest would be SMALL. As discussed in Section 5.8, the NRC staff is not able to come to a conclusion on the chronic impacts of EMFs.

9.3.4.10 Radiological Health Impacts of Normal Operations

The following impact analysis includes radiological impacts on the public and workers from building activities and operations for two nuclear units at the Keowee alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health, including other Federal and non-Federal projects and the projects listed in Table 9-10. As described in Section 9.3.4, the Keowee site is a greenfield site; there are currently no nuclear facilities on the site. The geographic area of interest is the area within a 50-mi radius of the Keowee site. The only facility potentially affecting radiological health within this geographic area of interest is the existing Oconee Nuclear Station, located about 1 mi north of the Keowee site. In addition, medical, industrial, and research facilities that use radioactive material are likely to be within 50 mi of the Keowee site.

The radiological impacts of building and operating the proposed two AP1000 units at the Keowee site include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways would result in low doses to people and biota offsite that would be well below regulatory limits. The impacts are expected to be similar to those at the Lee Nuclear Station site.

The radiological impacts of Oconee Units 1, 2, and 3 include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways result in low doses to people and biota offsite that are well below regulatory limits, as demonstrated by the ongoing radiological environmental monitoring program conducted around the Oconee Nuclear Station. The NRC staff concludes that the dose from direct radiation and effluents from medical, industrial, and research facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the Keowee site. This conclusion is based on data from the radiological environmental monitoring programs conducted around currently operating nuclear power plants. Based on the information provided by Duke and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed AP1000 units and other existing and planned projects and actions in the geographic area of interest around the Keowee site would be SMALL.

9.3.4.11 Postulated Accidents

The following impact analysis includes radiological impacts from postulated accidents from the operation of two nuclear units at the Keowee alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health from postulated accidents, including other Federal and non-Federal projects and the projects listed in Table 9-10. As described in Section 9.3.4, the Keowee site is adjacent to the existing Oconee Nuclear Station site. The geographic area of interest considers all existing and proposed nuclear power plants that have the potential to increase theprobability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Keowee alternative site. Facilities potentially affecting radiological accident risk within this geographic area of interest are the existing Oconee Units 1, 2, and 3 and VCSNS Unit 1. In addition, COLs have been issued for two units (Units 2 and 3) and are under construction at the VCSNS site. Nuclear Fuel Services Inc., located in Erwin, Tennessee, is also within the geographic area of interest.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of DBAs at the Lee Nuclear Station site would be minimal for AP1000 reactors. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The AP1000 design is independent of site conditions, and the meteorology of the Keowee alternative and Lee Nuclear Station sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the Keowee alternative site would be minimal.

Assuming the meteorology, population distribution, and land use for the Keowee alternative site are similar to the proposed Lee Nuclear Station site, risks from a severe accident for an AP1000 reactor located at the Keowee alternative site are expected to be similar to those analyzed for the proposed Lee Nuclear Station site. The risks for the proposed Lee Nuclear Station site are presented in Tables 5-14 and 5-15 and are well below the median value for current-generation reactors. In addition, as discussed in Section 5.11.2, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For existing plants within the geographic area of interest (Oconee Units 1, 2, and 3 and VCSNS Unit 1), the Commission has determined that the probability-weighted consequences of severe accidents are small (10 CFR Part 51, Appendix B, Table B-1). Finally, according to the *Final Environmental Impact Statement for Combined Licenses for Virgil C. Summer Nuclear Station Units 2 and 3*, NUREG-1939 (NRC 2011f), the risks from VCSNS Units 2 and 3 would also be well below risks for current-generation reactors and would meet the Commission's safety goals. There is no irradiated fuel located at Nuclear Fuel Services, Inc., and the facility is designed to prevent inadvertent criticalities; therefore, the additional risk is not significant in the evaluation of the cumulative severe accident risk for a nuclear power plant at the Keowee site. On this basis, the NRC staff concludes that the cumulative risks from severe accidents at any location within 50 mi of the Keowee alternative site would be SMALL.

9.3.5 The Middleton Shoals Site

This section covers the review team's evaluation of the potential environmental impacts of siting two nuclear units at the Middleton Shoals site located in Anderson County, South Carolina. The following sections describe the cumulative impact assessment conducted for each major resource area. The specific resources and components that could be affected by the incremental effects of the proposed action if it were implemented at the Middleton Shoals site, and other actions in the same geographic area were considered. This assessment includes the impacts of NRC-authorized construction, operations, and preconstruction activities. Also included in the assessment are other past, present, and reasonably foreseeable Federal, non-Federal, and private actions that could have meaningful cumulative impacts when considered together with the proposed action if implemented at the Middleton Shoals site. Other actions and projects considered in this cumulative analysis are described in Table 9-14.

Table 9-14. Past, Present, and Reasonably Foreseeable Projects and Other Actions Considered in the Middleton Shoals Alternative Site Cumulative Analysis

Project Name	Summary of Project	Location	Status
Nuclear Energy Projects			
Oconee Nuclear Station, Units 1, 2, and 3	Nuclear power generating plant with 3 units (846 MW(e) each)	Approximately 38 mi north of the Middleton Shoals site	Oconee's three units are currently operational and are licensed through February 6, 2033, October 6, 2033, and July 19, 2034 (NRC 2012a)
VCSNS Unit 1	Nuclear power generating plant with one unit (966 MW(e))	Approximately 81 mi east of the Middleton Shoals site	VCSNS Unit 1 is currently operational and is licensed through August 6, 2042 (NRC 2012a)
VCSNS Units 2 and 3	Nuclear power generating plant with two Westinghouse AP1000 pressurized water reactors	Approximately 81 mi east of the Middleton Shoals site	Proposed operation would begin in 2016 and 2019 (NRC 2011f). COLs issued March 30, 2012 (NRC 2012a)

Table 9-14. (contd)

Project Name	Summary of Project	Location	Status
VEGP	Nuclear power generating plant with two units, VEGP 1 (1109 MW(e)) and VEGP 2 (1127 MW(e))	Approximately 95 mi south-southeast of the Middleton Shoals site	VEGP's two units are operational and licensed through January 16, 2047 and February 9, 2049 (NRC 2012a)
VEGP Units 3 and 4	Nuclear power generating plant with two Westinghouse AP1000 pressurized water reactors	Approximately 95 mi south-southeast of the Middleton Shoals site	Combined licenses and limited work authorizations issued February 10, 2012 (NRC 2012a, 2012k). Proposed operation would be in 2016 for Unit 3 and 2017 for Unit 4.
Coal and Natural Gas Energy Projects			
John Rainey Generating Station	A 1095-MW, six-unit natural-gas-fired peaking facility	Approximately 6 mi north-northwest of Middleton Shoals site	Operational (EPA 2010an, Santee Cooper 2013)
Hartwell Energy Facility	A two-unit, 360-MW natural-gas-fired facility operated by Oglethorpe Power	Approximately 7 mi northwest of the Middleton Shoals site	Proposed upgrading existing plant controls including turbines (ARRA 2011, EPA 2010ap)
Lee Steam Station	A three-unit, 370-MW coal-fired power plant operated by Duke Energy	Approximately 29 mi northeast of the Middleton Shoals site	Operational (Duke Energy 2010p)
Plant Carl	A 25-MW generating plant fueled by wood and poultry waste	Approximately 35 mi west of the Middleton Shoals site	Proposed (GDNR 2009)
Plant Dahlberg	A ten-unit, 810-MW natural-gas-fired generating plant operated by Southern Company	Approximately 41 mi west of the Middleton Shoals site	Operational (GDNR 2010a) An additional 4 units are proposed (GDNR 2010b)
Buzzard Roost Combustion Turbine Station	A 196-MW oil/gas-fired peaking facility	Approximately 48 mi east of Middleton Shoals site	Operational (Duke Energy 2011e)

Table 9-14. (contd)

Project Name	Summary of Project	Location	Status
Various small-scale fossil and cogeneration generating facilities	Fossil fuel-fired and cogeneration facilities	Throughout the 50-mi region	Operational
Hydroelectric Energy Projects			
Hartwell Dam and Lake	USACE dam with four 85-MW units and one 80-MW unit	On the Savannah River approximately 8 mi northwest of the Middleton Shoals site	Operational (USACE 2010a)
Hartwell Power Plant Federal Contract	$290,000 funded to upgrade existing plant controls, including turbines	Within 15 mi	In progress (ARRA 2011)
Richard B. Russell Dam and Lake	USACE dam with four 75-MW turbines	On the Savannah River approximately 18 mi south-southeast of the Middleton Shoals site	Operational (USACE 2010b)
Keowee Hydroelectric Station	A 158-MW two-unit hydroelectric facility operated by Duke Energy	Approximately 38 mi north of the Middleton Shoals site	Operational (Duke Energy 2010q)
Yonah Hydroelectric Generating Plant	A 22-MW three-unit hydroelectric facility operated by Georgia Power	In Georgia, approximately 45 mi northwest of the Middleton Shoals site	Operational (Georgia Power 2010)
Buzzard's Roost Dam	A 15-MW hydroelectric facility operated by Greenwood County, South Carolina	Approximately 48 mi east of the Middleton Shoals site	Operational (FERC 2011b)
Tugalo Hydroelectric Generating Plant	A 22-MW hydroelectric facility operated by Georgia Power	In Georgia, approximately 47 mi northwest of the Middleton Shoals site	Operational (Georgia Power 2010)
Jocassee Hydroelectric Station	A 610-MW four-unit pumped-storage hydroelectric facility operated by Duke Energy	On the Keowee River approximately 49 mi north-northeast of the Middleton Shoals site	Operational (Duke Energy 2010r)

Table 9-14. (contd)

Project Name	Summary of Project	Location	Status
Tallulah Falls Hydroelectric Generating Plant	A 75-MW hydroelectric facility operated by Georgia Power	In Georgia, approximately 50 mi northwest of the Middleton Shoals site	Operational (Georgia Power 2010)
J. Strom Thurmond Dam and Lake	USACE dam with seven 40-MW turbines	On the Savannah River approximately 52 mi southeast of the Middleton Shoals site	Operational (USACE 2010c)
Various small-scale hydroelectric projects located on dams, including Ware Shoals Hydroelectric Project, Rocky River Project, Pelzer Upper and Lowe Hydroelectric Projects, and Barnett Shoals.	Run-of-river and dam storage hydroelectric projects ranging from 1–6 MW	Throughout the 50-mi region	Operational (USSD 2010)
Other Energy Projects			
DOE SRS	Research and industrial complex	Approximately 91 mi southeast of the Middleton Shoals site	Operational (DOE 2009c)
Transportation Projects			
South Carolina Strategic Corridor System Plan	Strategic system of corridors forming the backbone of the State's transportation system	Statewide	Planning document with no explicit schedules; however, many strategic corridors coincide with routes that would/could be used for development at the Middleton Shoals site[j]
Anderson County Transportation Grant	$14.7 million funded to improve highway infrastructure	Within 20 mi	In progress (ARRA 2011)
National Forests			
Sumter National Forest	371,000-ac national forest	Throughout 40- to 50-mi region	Currently managed by U.S. Forest Service (USFS 2004a)

Table 9-14. (contd)

Project Name	Summary of Project	Location	Status
Chattahoochee – Oconee National Forests	750,000-ac Chattahoochee National Forest, and 115,000-ac Oconee National Forest	Throughout 40- to 50-mi region	Currently managed by U.S. Forest Service (USFS 2004b). Recent land transfers have added additional acreage to the managed forest (USFS 2010b)
Other Facilities			
Mohawk Industries Rocky River Plant	Yarn spinning mill	Approximately 11 mi southeast of the Middleton Shoals site	Operational (EPA 2010aq)
Owens Corning	Pressed and blown glass and glassware	12 mi northeast of the Middleton Shoals site	Operational (EPA 2010ar)
Milliken and Co. Sharon Plant	Fabric mill	Approximately 12 mi east of the Middleton Shoals site	Operational (EPA 2010as)
Eliskim Inc.	Hazardous waste management	14 mi northeast	Operational (EPA 2004)
Michelin Starr Plant	Tire manufacturing	Approximately 14 mi north of Middleton Shoals	Operational (EPA 2011n)
Plastic Omnium Auto Exterior	Motor vehicle parts manufacturing	Approximately 20 mi north of Middleton Shoals	Operational (EPA 2011o)
Hydro Aluminum North America	Aluminum extruded products	Approximately 23 mi northeast of Middleton Shoals site	Operational (EPA 2011p)
Medline Industries	Fabricated rubber products	Approximately 23 mi northeast of Middleton Shoals site	Operational (EPA 2011q)
Michelin Sandy Springs Plant	Tire manufacturing	Approximately 23 mi north of Middleton Shoals site	Operational (EPA 2011r)
Milliken Pendleton Plant	Fabric finishing	Approximately 28 mi north of Middleton Shoals	Operational (EPA 2011s)

Table 9-14. (contd)

Project Name	Summary of Project	Location	Status
Milliken-Cushman Plant	Fabric mill	Approximately 28 mi northeast of Middleton Shoals	Operational (EPA 2011t)
Fibertech Columns Inc.	Plastic products	Approximately 31 mi north of Middleton Shoals site	Operational (EPA 2011u)
Big Creek East Waste Water Treatment Plant	Improvements to take effluents out of Saluda River	Approximately 29 mi northeast of the Middleton Shoals site	Operational. Proposed improvements funded (ARRA 2011).
Various wastewater-treatment plants	Municipal wastewater treatment	Various locations throughout the region	Operational
Surface mines including the Threlko Pits, the Little River Sand Company Mine, and the Anderson Quarry	Surface mining operations for construction materials	Various locations within the region	Operational
Little River Sand Company Mine	Construction sand and gravel	15 mi east of the Middleton Shoals site	Operational (EPA 2010at)
Hanson Aggregates Southeast Incorporated Anderson Quarry	Crushed and broken granite	11 mi northeast of the Middleton Shoals site	Operational (EPA 2010au)
Mearl Corp Sfm Div	Dimension stone	13 mi west of the Middleton Shoals site	Operational (EPA 2010av)
Mohawk Industries Rocky River Plant	Yarn-spinning mills	11 mi southeast of the Middleton Shoals site	Operational (EPA 2010aw)
S&S Const/Broadway Pit	Miscellaneous nonmetallic minerals	15 mi northeast of the Middleton Shoals site	Operational (EPA 2010ax)
Threlko/Bob Quinn Pit	Miscellaneous nonmetallic minerals	13 mi southeast of the Middleton Shoals site	Operational (EPA 2010ay)
Threlko/Frank Hodges Pit #2.1	Miscellaneous nonmetallic minerals	15 mi southeast of the Middleton Shoals site	Operational (EPA 2010az)
Threlko/Pit #4	Miscellaneous nonmetallic minerals	16 mi southeast of the Middleton Shoals site	Operational (EPA 2010ba)
Threlko/Pit #5	Miscellaneous nonmetallic minerals	14 mi southeast of the Middleton Shoals site	Operational (EPA 2010bb)
Threlko/Pit #6	Miscellaneous nonmetallic minerals	14 mi southeast of the Middleton Shoals site	Operational (EPA 2010bc)

Table 9-14. (contd)

Project Name	Summary of Project	Location	Status
Threlko/Roger Pit #4.1	Miscellaneous nonmetallic minerals	16 mi southeast of the Middleton Shoals site	Operational (EPA 2010bd)
Vulcan Const Mat/Anderson Quarry	Crushed and broken granite	18 mi Northeast of the Middleton site	Operational (EPA 2010be)
Other Actions/Projects			
Elberton Energy Efficiency Grant	$66,000 funded to improve energy efficiency and reduce fossil fuel emissions	Within 20 mi	In progress (ARRA 2011)
Hartwell Lake, Dam, Power Plant, and Clemson Pumping Station Federal Contract	$1.5 million funded to construct five or six campsites/recreational sites, perform shoreline stabilization work, clean power plant foundation drains, and construct restroom facilities at recreation sites	Within 15 mi	In progress (ARRA 2011)
Department of Commerce Grant to Hart County	$1.4 million funded to expand broadband access across Georgia by building four new access points to offer affordable high-speed services to underserved areas	Within 20 mi	In progress (ARRA 2011)

Table 9-14. (contd)

Project Name	Summary of Project	Location	Status
Abbeville Community Grant	$10 million funded to Abbeville community to modernize and make long-term investments in infrastructure and public facilities that will assist residents living in areas with high unemployment and low income, help prevent crimes, a separate grant for highway infrastructure used anywhere, as well as another highway infrastructure grant to improve transportation.	Within 25 mi	In progress (ARRA 2011)
Various hospitals	Medical isotopes	Within 50 mi	Operational in Abbeville, Greenwood, Laurens, Anderson, McCormick, Pickens, Greenville, Oconee Counties, SC, and Hart, Stephens, Banks, Franklin, Jackson, Madison Elbert, Oglethorpe, Wilkes, Clarke, Greene, Taliaferro, Lincoln, McDuffie and Columbia Counties, NC
Commercial dairies and poultry farms	Commercial production of animal products	Throughout the 50-mi region	Operational
ARRA-funded grant for safe drinking water	$1.3 million funded to the town of Iva for improving drinking-water facilities, green infrastructure, program administration, and drinking-water-related activities	Within 10 mi of the Middleton Shoals site	In progress (ARRA 2011)

Table 9-14. (contd)

Project Name	Summary of Project	Location	Status
Star-Iva Water and Sewer District Grants and Loans	$15.5 million funded to improve and update the water lines and water-storage tank and related appurtenances	Within 10 mi of the Middleton Shoals site	In progress (ARRA 2011)
TEPA Federal Contract for navigation barriers on Russell Lake	$101,000 funded to aid navigation (boat barrier) on Russell Lake	Within 10 mi of the Middleton Shoals site	Completed (ARRA 2011)
Future Urbanization	Construction of housing units and associated commercial buildings; roads, bridges, and railroad; construction of water- and/or wastewater-treatment and distribution facilities and associated pipelines, as described in local land-use planning documents.	Throughout region.	Construction would occur in the future, as described in State and local land-use planning documents. Current projects include public infrastructure development and refurbishment projects funded by the American Recovery and Reinvestment Act of 2009.

Middleton Shoals is a greenfield site located on the eastern bank of the Savannah River, approximately 8 mi downstream of Hartwell Dam. The Middleton Shoals site has been maintained as forestland. The site would require extensive grading and cut-fill activities to support a two-unit nuclear power facility. Figure 9-8 shows the Middleton Shoals site region.

The Savannah River forms the western boundary of the site; US-187 and US-184 converge and form the eastern boundary of the site, and US-184 also provides the southern boundary. Iva, South Carolina, is approximately 6 mi east of the site and Anderson, South Carolina, is approximately 15 mi north of the site.

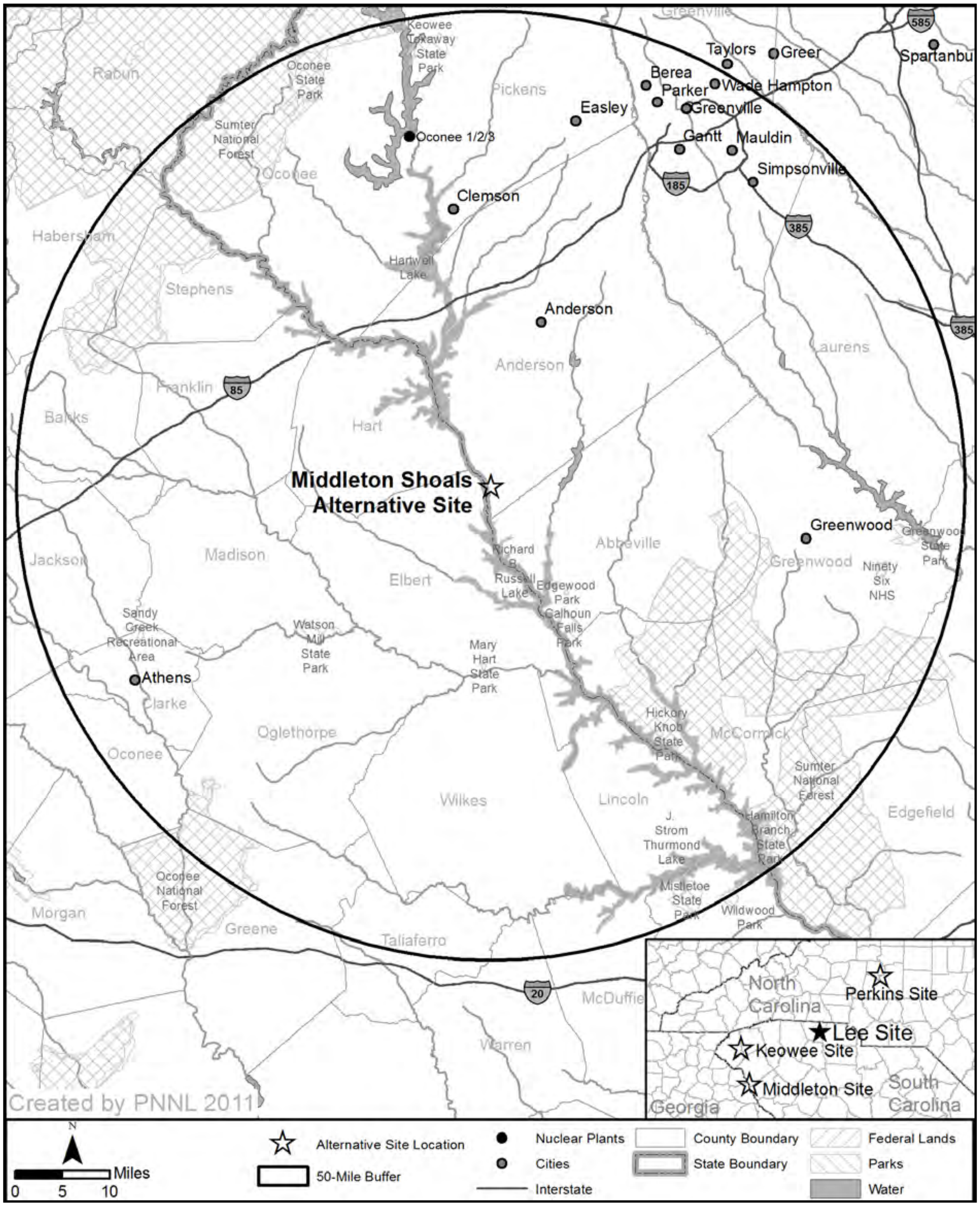

Figure 9-8. The Middleton Shoals Site Region

9.3.5.1 Land Use

The following analysis addresses impacts on land use from building and operating two new nuclear generating units at the Middleton Shoals site in Anderson County, South Carolina. In addition to land-use impacts from building and operations, the cumulative analysis for the Middleton Shoals site considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative land-use impacts, including other Federal and non-Federal projects and the projects listed in Table 9-14.

Site Description

The Middleton Shoals site is located in Anderson County, South Carolina, south of the town of Anderson, near the northwest border of South Carolina on the Savannah River/Russell Reservoir, and downstream from the Hartwell Dam. The site is not in the coastal zone. Anderson County is primarily rural with significant agricultural activities. To the north of Anderson County is Pickens County, South Carolina, which includes the town of Clemson. Also included in the 50-mi region of the Middleton Shoals site are the large metropolitan areas of Greenville, South Carolina and Athens, Georgia. Several State, U.S., and interstate highways currently traverse the area.

The Middleton Shoals site is a greenfield site (Duke 2009c), and would require extensive grading and development of an offsite supplemental water reservoir for low-flow events (Duke 2010g). The site grade elevation is 550 ft with a maximum flood elevation of 450 ft; therefore, no flood plains exist onsite (Duke 2009c). Very little residential development exists on or in the vicinity of the site where the supplemental pond and ancillary facilities would be built. SC 187 and SC 184 meet near the site and connect to SC 81 and SC 181.

Building and Operation Impacts

Based on information provided by the applicant and the review team's independent assessment, development of the proposed new units would require about 450 ac on the Middleton Shoals site (Duke 2009c) and a 3700-ac supplemental cooling reservoir offsite (Duke 2010g). A 15.3-mi railroad spur would have to be built to support construction deliveries. Widening of current roads, realignment of 7 mi of road, and development of a new access road would also be needed. Approximately 12.6 mi of transmission-line corridor would be built as well as 1 mi of cooling-water pipeline (Duke 2010g). When routing the transmission line, Duke would avoid populated areas and residences; however, land currently used for forests or timber production would be altered. These areas would be replaced with grasses and other types of ground cover (Duke 2009c). Table 9-15 summarizes expected land-use impact parameters for the Middleton Shoals site, supplemental reservoir, and ancillary facilities.

Table 9-15. Land-Use Impact Parameters for the Middleton Shoals Site

Parameter	Value	Source
Required project area	450 ac	Duke (2009c)
Number of supplemental water reservoirs	1	Duke (2009c)
Supplemental water reservoirs, area required	3700 ac	Duke (2010g)
Ancillary facilities	560 ac	Duke (2010g)
Number of new transmission-line routes	1	Duke (2010g)
Total transmission-line corridor distance (270-ft-wide corridor)	12.6 mi	Duke (2010g)
Railroad spur distance (100-ft-wide corridor)	15.3 mi	Duke (2010g)
Cooling-water pipeline (50-ft-wide corridor)	1.0 mi	Duke (2010g)
Road realignment (100-ft-wide corridor)	7.0 mi	Duke (2010g)

Cumulative Impacts

For the analysis of land-use impacts at the Middleton Shoals site, the geographic area of interest is considered to be the 50-mi region centered on the Middleton Shoals site, which includes all transmission-line corridors. Land-use planning for transmission-line routing over wide areas must consider land-use plans of adjoining counties and other land-managing agencies, rather than considering one county in isolation. Furthermore, in predominantly rural settings such as that surrounding the Middleton Shoals site, land-use changes occurring substantial distances away from a project site can substantially influence land-use planning decisions close to the site. Roads and other public facilities and services in rural areas tend to serve people who are spread thinly but broadly over large portions of the landscape. Therefore land-use changes can affect roads and other facilities at greater distances than similar changes in more densely populated areas.

The proposed project would indirectly result in land conversions to residential areas, roads, and businesses to accommodate growth, new workers, and services related to the proposed nuclear facility. Other reasonably foreseeable projects in the area that could contribute to an increase in urbanization include potential development of new residences within easy commuting distance of the new plant and the development and upgrading of local roads and highways. Because the other projects described in Table 9-14 do not include any reasonably foreseeable changes in land-use types within 50 mi of the Middleton Shoals site, other than general growth and urbanization development, there would not be any significant additional cumulative impacts on land use from those activities.

As described above, building the proposed facilities, new transmission-line corridors, inundation for a supplemental water reservoir, and building the water intake and railroad spur to support the new units may affect as much as 4710 ac of land. The overall impact of these activities on land use would be noticeable and permanent, particularly in the area containing the supplemental reservoir. If additional transmission lines are built from other energy projects, there would be a further cumulative land-use impact from the additional amount of land converted to utility corridor use for transmission lines. Because transmission lines are often co-located and are relatively narrow, the review team expects that the cumulative impact would be consistent with the land-use plans and zoning regulations of the affected counties. Nonetheless, consistent with previous discussions, new transmission-line corridors could noticeably alter the land-use classification acreage proportions within the geographic area of interest.

Due to the potential reclassification of acreage within the region for the project, the transmission-line development and the supplemental reservoir, the review team concludes that the cumulative land-use impacts associated with the proposed project at the Middleton Shoals site and other projects in the geographic area of interest would be MODERATE. Considering the land needs noted above, building and operating two new nuclear units at the Middleton Shoals site would be a significant contributor to these impacts.

9.3.5.2 Water Use and Quality

This section describes the review team's assessment of impacts on water use and quality associated with building and operating two new nuclear units at the Middleton Shoals site. The assessment also considers other past, present, and reasonably foreseeable future actions that affect water use and quality, including the other Federal and non-Federal projects listed in Table 9-14. The Middleton Shoals site hydrology, water use, and water quality are discussed in the ER (Duke 2009c) and in the response to RAIs (Duke 2010l).

The geographic area of interest for the Middleton Shoals site is considered to be the drainage basin of the Savannah River upstream and downstream of the site because this is the resource that would be affected if the proposed project were located at the Middleton Shoals site. For groundwater, the geographic area of interest is limited to the site because Duke has indicated no plans for use of groundwater to build and operate the plant (Duke 2009c).

The cooling- and service-water supply for a two-unit nuclear generating station located at the Middleton Shoals site would be Russell Reservoir. The USACE manages Russell Reservoir and Duke notes that "supplemental make-up cooling water would be required at the Middleton Shoals site whenever the USACE declares a drought stage of three (3) or greater" (Duke 2010l). Declaration of drought stage 3 is based on water levels in Lake Hartwell, which is upstream of Russell Reservoir and water levels in Lake Thurmond, which is downstream of Russell Reservoir. Russell Reservoir is listed as impaired by South Carolina for mercury in fish tissue and the Savannah River downstream of the alternative site location is listed as impaired for mercury, fecal coliform, and turbidity (EPA 2010am).

Building Impacts

Because the building activities at the Middleton Shoals site would be similar to those at the Lee Nuclear Station site, the review team estimated that the water needed for building activities at the Middleton Shoals site would be identical to the proposed amount of water use for building at the Lee Nuclear Station site. Consistent with the Lee Nuclear Station, the review team assumed that groundwater would not be used. During building activities at the Lee Nuclear Station site, the average estimated water use is projected to be 250,000 gpd or 0.39 cfs (Table 3-5). The review team assumed that surface water from Russell Reservoir would be used at the Middleton Shoals site for potable and sanitary use as well as for various building-related activities. This water-use rate is inconsequential when compared to the volume of Russell Reservoir. The review team assumed that building activities could cease, if needed, during drought emergency conditions without any significant overall impact on schedule. Because the surface-water withdrawal would be minor compared to the reservoir volume and because the withdrawal from the reservoir would be temporary and limited to the building period, the review team concludes that the impact of surface-water use for building the potential units at the Middleton Shoals site would be minimal.

Duke stated that it would need to develop a cooling-water reservoir at the Middleton Shoals site to support station operations. Historically, Lake Hartwell and Lake Thurmond have been in a Stage 3 drought designation for up to 158 days (Duke 2010l). Development of two nuclear units at the Middleton Shoals site would require building an additional reservoir with a storage capacity of 115,000 ac-ft to provide cooling water for plant operations during droughts. Cooling water would be supplied from Russell Reservoir (Duke 2009c). Duke would alter the drainage of a tributary creek to the Savannah River to create the storage volume needed to supply cooling water during future droughts of the magnitude experienced in the historical worst-case drought (Duke 2010l). Because a single creek would be affected and the drainage area is small relative to the area of the Savannah River Basin, changes to flow in the Savannah River system as a result of building the reservoir would not be detectable.

As stated above, the review team assumed that no groundwater would be used to build the units at the Middleton Shoals site. The review team also assumed that the impact of dewatering the excavations needed for building two units at the site would be temporary and minor at the Middleton Shoals site because technology (e.g., slurry walls and grouting) is readily available to control water inflow to the excavation if needed. Therefore, because there would be no groundwater use and the impact of dewatering would be temporary and minor, the review team determined that there would be minimal impact on groundwater resources.

Surface-water quality could be affected by stormwater runoff during site preparation and the building of the facilities. The SCDHEC would require Duke to develop an SWPPP. The SWPPP would identify BMPs to control the impacts of stormwater runoff. The review team anticipates that Duke would construct new detention and infiltration ponds and drainage ditches to control delivery of sediment from the disturbed area to nearby waterbodies. Sediment carried with stormwater from the disturbed area would settle in the detention ponds and the stormwater would infiltrate into the shallow aquifer. As a result, stormwater runoff is not anticipated to affect water quality in the Russell Reservoir. Therefore, during building activities, the surface-water-quality impacts near the Middleton Shoals site would be temporary and minimal.

While building new nuclear units at the Middleton Shoals site, impacts on groundwater quality may occur from leaching of spilled effluents into the subsurface. The review team assumes that the BMPs Duke has proposed for the Lee Nuclear Station site would also be in place during building activities at the Middleton Shoals site, and therefore the review team concludes that any spills would be quickly detected and remediated. As discussed in Section 4.2.3.1, the development of an SWPPP with its call for implementation of BMPs would minimize water-quality impacts. Because any spills related to building activities would be quickly remediated under BMPs, and the activities would be temporary, the review team concludes that the groundwater-quality impacts from building at the Middleton Shoals site would be minimal.

Operational Impacts

The review team assumed that the cooling-water system for the proposed plant, if built and operated at the Middleton Shoals site, would be similar to that proposed at the Lee Nuclear Station site; specifically, the cooling-water system would withdraw water from Russell Reservoir, use cooling towers, and blowdown would be discharged back to Russell Reservoir.

Duke proposes a new reservoir with a storage capacity of 115,000 ac-ft at the Middleton Shoals site would provide supplemental water when adequate water from Russell Reservoir may not be available (Duke 2010l). Duke did not provide details of the cooling-water intake and effluent discharge locations. However, it is standard practice for power plants to design cooling-water intake and effluent discharge locations such that recirculation of discharged effluent to the intake does not occur.

Duke determined that the total amount of water required to operate two units would be approximately 35,000 gpm (78 cfs). About 2000 gpm (4.5 cfs) would be used for the screen wash system and thus return to the river at the intake location. As indicated for the Lee Nuclear Station in Chapter 3, consumptive losses through evaporation and drift from cooling two units would be approximately 24,700 gpm (55 cfs) (Duke 2009c). The remaining 18 cfs would be returned via pipeline to the lake at the discharge location.

The source of water for this site would be from Russell Reservoir, which would support the 55 cfs consumptive withdrawal for the new units. A 115,000 ac-ft supplemental water reservoir would need to be built to supply water during low water availability periods. When water levels in Lake Hartwell and Thurmond Lake drop below drought stage 3 levels, water from a supplemental water-storage reservoir would be required or operation of the plant would need to be curtailed. The proposed 115,000 ac-ft reservoir would allow the plant to operate for 158 days without relying on Russell Reservoir (Duke 2010l). Based on the small fraction of available water that would be used during normal conditions and the availability of the proposed water-storage reservoir for use during low water availability periods, the review team determined that the operational impact of the proposed plant at the Middleton Shoals site on surface water would be minimal. Similar to the Lee Nuclear Station, the reservoir refill rate was assumed to be 200 cfs. This would be limited based on current reservoir conditions and would only be used after the reservoir had been drawn down to provide water for plant operation during drought periods.

As stated above, the review team assumed that no groundwater would be used to operate the units at the Middleton Shoals site. Therefore, because there would be no groundwater use, the review team determined that there would be no impact on groundwater resources.

During the operation of the proposed plant at the Middleton Shoals site, impacts on surface-water quality could result from stormwater runoff, discharges of treated sanitary and other wastewater, and blowdown from cooling towers into the Russell Reservoir. The review team assumed that the blowdown rate would be the same as that at the Lee Nuclear Station site, 8216 gpm (18 cfs). Blowdown would be regulated by SCDHEC pursuant to 40 CFR Part 423 and all discharges would be required to comply with limits established by SCDHEC in an NPDES permit.

The SCDHEC would require Duke to develop an SWPPP. The plan would identify measures to be used to control stormwater runoff. Because stormwater controls would be in place and blowdown discharges would be regulated under an NPDES permit, the review team concludes that the impacts on surface-water quality from operation of two nuclear units at the Middleton Shoals site would be minimal.

During the operation of new nuclear units at the Middleton Shoals site, impacts on groundwater quality could result from potential spills. Spills that might affect the quality of groundwater would be prevented or remediated by using BMPs. Because BMPs would be used to quickly remediate spills and no intentional discharge to groundwater should occur, the review team concludes that the impacts on groundwater quality from operation of two nuclear units at the Middleton Shoals site would be minimal.

Cumulative Impacts

In addition to water-use and water-quality impacts from building and operations activities, cumulative impacts analysis considers other past, present, and reasonably foreseeable future actions that affect the same environmental resources. For the cumulative analysis of impacts on surface water, the geographic area of interest for this alternative site is considered to be the drainage basin of Savannah River upstream and downstream of the site because it is the resource that would be affected by the proposed project.

Key actions that have past, present, and future potential impacts on surface-water supply and surface-water quality in this drainage basin include the operation of the Russell Dam that forms Russell Lake and other dams and reservoirs upstream and downstream of the Middleton Shoals site. Upstream is Lake Hartwell created by Hartwell Dam and Lake Keowee created by dams on the Keowee River (Keowee Dam) and on the Little River (Little River Dam). Upstream of Lake Keowee is the Jocassee Hydroelectric Station, a 610-MW pumped-storage facility that creates Lake Jocassee. Downstream of the site is Thurmond Lake and Thurmond Dam. These dams increase the reliability of water supply to the region and to provide power.

The Oconee Nuclear Station, which includes three 846-MW units and is located upstream on Lake Keowee, has past, present, and future impacts on water quality and water supply in the region because it uses Lake Keowee as a source of cooling water. Additional actions that have past, present, and future potential impacts on water supply and water quality in the Savannah River Basin include operating SCE&G's Urquhart Station (a fossil-fueled electrical generating plant) (SCE&G 2009a), operating and decommissioning DOE facilities at the SRS, operating two existing nuclear power plants at the Vogtle site, building and operating two new power plants at the Vogtle site (NRC 2008h), and other municipal and industrial activities in the Savannah River Basin.

The GCRP has compiled the state of knowledge in climate change (GCRP 2009). This compilation has been considered in the preparation of this EIS. The projections for changes in temperature, precipitation, droughts, and increasing reliance on aquifers within the Savannah River Basin are similar to those at other alternative sites in the region. These regional changes are discussed in Section 7.2 of this EIS.

Cumulative Water Use

Based on a review of the GCRP assessment of the Southeast United States region, the review team conservatively estimated a decrease in streamflow of 10 percent over the life of the station. This reduction in streamflow will result in a higher incidence of times when water levels in Lake Hartwell and Lake Thurmond drop below drought stage 3 levels and use of the supplemental reservoir would be needed. The review team also considered the increased water demands associated with an increased population in the region. The SCDNR indicates that "water demand for industry, public supply, crop and golf course irrigation, and domestic use is expected to increase by nearly 50 percent between the years 2000 and 2045" (SCDNR 2004).

By considering the impact of climate change on historical flows and allowing for continued increase in water demand due to population growth in the region, the review team determined that the reservoir would be needed more frequently as time goes on and, in some instances, the plant would exhaust its water supply and the units might be required to derate or cease operation.

The impacts of the other projects listed in Table 9-14 are considered in the analysis included above or would have little or no impact on surface-water use. The projects believed to have little impact are excluded from the analysis either because they are too distant from the Middleton Shoals site, use relatively little or no surface water, or have little or no discharge to surface water. Some projects (e.g., park and forest management) are ongoing, and changes in their operations that would have large impacts on surface-water use appear unlikely.

The review team determined that the cumulative impacts on water supply associated with operation of the proposed units, other water users, climate change, and population growth would be MODERATE, but the incremental impact associated with water use for the Middleton Shoals site was determined not to be a significant contributor to the MODERATE impact.

As stated above, the review team assumed that no groundwater would be used to build or operate the units at the Middleton Shoals site and that groundwater impacts from dewatering would be temporary and minor. Therefore, the review team determined that the Middleton Shoals site by itself would have minimal impact on groundwater resources.

Other projects listed in Table 9-14 are, for the most part, 7 or more miles away from the Middleton Shoals site and so will not contribute to a cumulative impact on groundwater supply. Because groundwater-use impacts are limited and temporary due to aquifer dewatering during the building phase, and other projects are not anticipated near the Middleton Shoals site, the review team concludes that cumulative impacts on groundwater use at the alternative site would be SMALL.

Cumulative Water Quality

Point and nonpoint sources have affected the water quality of the Savannah River upstream and downstream of the Middleton Shoals site. The Savannah River appears on South Carolina's list of impaired waters for a variety of parameters including the presence of mercury in fish tissue (SCDHEC 2011c); Russell Reservoir appears on the list for the presence of mercury and polychlorinated biphenyls in fish tissue. The impacts of other projects listed in Table 9-14 are either considered in the analysis included above or would have little or no impact on surface-water quality. Therefore, the review team concludes that the cumulative impact on surface-water quality of the receiving waterbody would be MODERATE. Water-quality information presented above for the impacts of building and operating the proposed new units at the Middleton Shoals site would also apply to evaluation of cumulative impacts. As mentioned above, the State of South Carolina requires an applicant to develop an SWPPP. The plan would identify measures to be used to control stormwater runoff. The blowdown would be regulated by EPA pursuant to 40 CFR Part 423 and all discharges would be required to comply with limits established by the SCDHEC in an NPDES permit. Such permits are designed to protect water quality. Therefore, because industrial and wastewater discharges from the proposed units would comply with NPDES permit limitations and any stormwater runoff from the site during operations would comply with the SWPPP, the review team concludes that building and operating the proposed units at the Middleton Shoals site would not be a significant contributor to cumulative impacts on surface-water quality.

Other projects listed in Table 9-14 are, for the most part, 7 or more miles away from the Middleton Shoals site and so would not contribute to a cumulative impact on groundwater quality in the ROI. The review team also concludes that with the implementation of BMPs, the cumulative impacts of groundwater quality from building and operating two new nuclear units at the Middleton Shoals site would likely be minimal. Therefore, the cumulative impact on groundwater quality would be SMALL.

9.3.5.3 Terrestrial and Wetland Resources

The following analysis includes impacts from building and operating the proposed new facilities on terrestrial ecology resources at the Middleton Shoals site. The analysis also considers past, present, and reasonably foreseeable future actions that affect the terrestrial ecological resources, including other Federal and non-Federal projects and the projects listed in Table 9-14. For the analysis of terrestrial ecological impacts at the Middleton Shoals site, the geographic area of interest includes portions of Anderson and Abbeville Counties, South Carolina, and portions of Elbert and Hart Counties, Georgia, that are within a 15-mi radius of the Middleton Shoals site. This area encompasses the supplemental cooling-water reservoir and all the ancillary facilities (one transmission line, a cooling-water pipeline, a railroad spur, and a road alignment), and the important animal and plant species and communities that could be potentially affected. The 15-mi distance was used by the SCDNR for its species and community of concern occurrence analysis. Because the 15-mi distance encompassed roughly two-thirds of the land area of the affected counties in Georgia, county-wide records of species and communities from the Georgia Department of Natural Resources (GDNR) were also used.

In developing this EIS, the review team relied upon reconnaissance-level information to perform the alternative site evaluation in accordance with ESRP 9.3 (NRC 2000a). Reconnaissance-level information is data that are readily available from agencies and other public sources such as scientific literature, books, and Internet websites. It also can include information obtained through site visits. To identify terrestrial resources at the Middleton Shoals site, the review team relied primarily on the following information:

- A tour of the Middleton Shoals alternative site in April 2008 (NRC 2008d) and a tour of the Middleton Shoals site and reservoir site in August 2010 (NRC 2010c)
- Lee Nuclear Station COL ER and supplement (Duke 2009b, c)
- Lee Nuclear Station Joint Application for Activities Affecting Waters of the United States submitted by Duke (2011h) to the USACE

- responses to RAIs provided by Duke (2010f, g)
- FWS Endangered Species Program database for South Carolina (FWS 2012a) and Georgia (FWS 2012c), and South Carolina (SCDNR 2012n, p) and Georgia (GDNR 2011a) Natural Heritage Program county record searches
- correspondence regarding species occurrence from the SCDNR (SCDNR 2012b).

Site Description

The Middleton Shoals site is situated within the Piedmont ecoregion in South Carolina (Griffith et al. 2002). As described in Section 7.3.1, the Piedmont ecoregion has been altered to a great extent since European settlement, primarily because of farming, agriculture, and silviculture. National Land Cover Data based on 2006 imagery (MRLC 2011) indicate that land cover within a 15-mi radius of the Middleton Shoals plant site consists of forest (approximately 48 percent), including deciduous forest (approximately 29 percent), evergreen forest (approximately 18 percent), and mixed forest (approximately 1 percent); early succession shrub/scrub and grassland/herbaceous cover (approximately 11 percent); wetlands (mostly woody) (approximately 2 percent); agriculture (pasture and cultivated crops) (approximately 22 percent); developed land (approximately 8 percent); and open water (approximately 9 percent). Forest habitat is highly fragmented, and much of it occurs in the area surrounding Lake Russell.

Duke provided a description of the vegetation cover types within a 2500-ft radius of the center of the Middleton Shoals site, covering about 450 ac. Cover types consist of pine/mixed hardwood (144 ac), upland scrub (104 ac), mixed hardwood (99 ac), pine (58 ac), mixed hardwood/pine (21 ac), open/field/meadow (13 ac), open water (11 ac), and wetlands (1.2 ac) (Duke 2009b, 2010f). Hardwood and mixed hardwood forest, which provide higher quality habitat to wildlife than pine or open/field/meadow, comprise 264 ac or about 60 percent of the Middleton Shoals site. As described in Section 9.3.5.1, operation of new facilities at the Middleton Shoals site would require one offsite supplemental cooling-water reservoir and ancillary facilities consisting of a railroad spur, a transmission line, a cooling-water pipeline, and a road realignment.

The staff visited the Middleton Shoals site in April 2008 (NRC 2008d) and the Middleton Shoals site and the site of the cooling-water reservoir in August 2010 (NRC 2010c). The presumed power block area consists mostly of mature pine forest with a hardwood understory that is being actively managed, as evidenced by recent thinning. The cooling reservoir watershed consists of an approximately 40-yr-old hardwood forest riparian corridor surrounded by managed pine forests interspersed with agricultural fields. The reservoir site watershed is characteristic of small stream watersheds in the Piedmont ecoregion.

Federally Listed and State-Ranked Species

Duke provided no field survey information for the Middleton Shoals site. The review team is not aware of any biological field surveys of the area of the Middleton Shoals site, or the site of the cooling-water reservoir, the transmission-line corridor, water-pipeline corridor, railroad corridor, or road realignment.

The presence/absence of Federally listed and State-ranked species in the project footprint cannot be ascertained without site-specific field surveys. However, a query of the South Carolina rare, threatened, and endangered species inventory database (SCDNR 2012b) and county-wide records from the Georgia rare species and natural community database (GDNR 2011a) identified 24 plant and animal species that are either Federally listed as endangered or are ranked by the States of South Carolina and Georgia as critically imperiled, imperiled, or vulnerable (Table 9-16) in Anderson and Abbeville Counties, South Carolina, and Elbert and Hart Counties, Georgia. One of the State-ranked animal species in South Carolina and Georgia (bald eagle) and some of the State-ranked plant species in Georgia also have been assigned a State protection status as threatened or endangered (Table 9-16). The State ranking (in addition to the Federal listing) provides a common basis for comparing important animal and plant species among the Lee, Perkins, Keowee, and Middleton Shoals sites.

Of the 24 taxa documented in Table 9-16, one is Federally listed as endangered, Michaux's sumac. Michaux's sumac occurs in sandy or rocky open woods, usually on ridges with a disturbance history (periodic fire, prior agricultural use, maintained transmission right-of-way). Michaux's sumac is presumed to be extirpated in South Carolina (Table 9-16), and the only confirmed extant population in naturally-functioning habitat in Georgia is located in Elbert County (FWS 2013), which is across the Savannah River from the Middleton Shoals site. This species is not known to occur within or near the Middleton Shoals site or the site of the cooling-water reservoir. However, as noted above, open field, early successional habitat is present within the geographic area of interest and on the Middleton Shoals site. Therefore, suitable habitat for this species could be present on the Middleton Shoals site and the site of the cooling-water reservoir and ancillary facilities.

Two State-ranked plant species, pale yellow trillium (*Trillium discolor*) and southern adder's tongue fern (*Ophioglossum vulgatum* [=*O. pusillum*]), have been documented within the vicinity of the railroad spur (Duke 2010g). Pale yellow trillium occurs in rich cove forests and is restricted to the Savannah River drainage (Weakley 2010). It is not known from Anderson or Abbeville Counties, South Carolina, but is known from Elbert and Hart Counties, Georgia, where it is considered to be critically imperiled (Table 9-16). Southern adder's tongue fern occurs in moist streamside meadows (Weakley 2010), and of the four counties in the geographic area of interest, it is known to occur only in Abbeville County, South Carolina. The species is considered imperiled in South Carolina (Table 9-16).

Table 9-16. Terrestrial Federally Listed Species and State-Ranked Species within 15 mi of the Middleton Shoals Site in Anderson and Abbeville Counties, South Carolina, and County-Wide Across Elbert and Hart Counties, Georgia

Scientific Name	Common Name	Federal Status[a]	SC State Rank/ Protection Status[b]	GA State Rank/ Protection Status[b]	Counties of Occurrence	Habitat[c]
Mammals						
Sylvilagus aquaticus	swamp rabbit	-	S2	NA	Anderson	mature forests in floodplains, bottomlands, riparian areas
Birds						
Haliaeetus leucocephalus	bald eagle	BGEPA	S2/ST	S2/T	Abbeville, Anderson, Hart	major rivers, large lakes, reservoirs[d]
Tyto alba	barn owl	-	S4	S3	Hart	nests in buildings, caves, crevices on cliffs, burrows, and hollow trees
Plants						
Clematis ochroleuca	curly-heads	-	NA	S2	Elbert	dry woodlands and woodland borders
Collinsonia verticillata	whorled horse-balm	-	S3	NA	Abbeville, Anderson	rich moist (cove) forests to dry oak forests
Juniperus communis var. *depressa*	ground juniper	-	SNR	S1	Elbert	in thin soil around rock outcrops on mountain summits and Piedmont monadnocks and rocky bluffs
Lithospermum tuberosum	tuberous gromwell	-	S1	NA	Abbeville	nutrient-rich forests

Table 9-16. (contd)

Scientific Name	Common Name	Federal Status[a]	SC State Rank/ Protection Status[b]	GA State Rank/ Protection Status[b]	Counties of Occurrence	Habitat[c]
Lotus helleri (=Acmispon helleri)	Carolina trefoil	-	NA	S1/E	Elbert	dry woodlands and openings, originally probably prairie-like sites, now along roadbanks, railroads, powerline rights-of-way
Lysimachia fraseri	Fraser's loosestrife	-	S3	NA	Anderson	hardwood forests, forest edges and roadbanks, thin soils around rock outcrops
Monotropsis odorata	sweet pinesap	-	S2	S1/T	Elbert	dry to mesic upland woods under oaks and/or pines
Ophioglossum vulgatum (= *O. pusillum*)	southern adder's-tongue fern	-	S2	NA	Abbeville	moist streamside meadows
Pachysandra procumbens	Allegheny-spurge	-	S2	S1	Abbeville	moist rich woods
Platanthera lacera	green-fringe orchis	-	S2	NA	Abbeville, Anderson	swamps, bogs, seepages
Quercus oglethorpensis	Oglethorpe oak	-	S3	S2/T	Elbert	bottomland forests, upland oak flats
Rhus michauxii	Michaux's sumac	E	SX	S1/E	Elbert	sandy or rocky open woods, usually on ridges with a disturbance history (periodic fire, prior agricultural use, maintained right-of-way)[e]

Table 9-16. (contd)

Scientific Name	Common Name	Federal Status[a]	SC State Rank/ Protection Status[b]	GA State Rank/ Protection Status[b]	Counties of Occurrence	Habitat[c]
Sedum pusillum	granite stonecrop	-	S2	S3/T	Elbert	granite outcrops
Scirpus expansus	woodland bulrush	-	NA	S1	Elbert	bogs, marshes, streambeds
Thermopsis fraxinifolia	ash-leaf bush-pea	-	NA	S2	Elbert	dry slopes and ridges
Tradescantia roseolens	rosy spiderwort	-	NA	S2	Elbert, Hart	dry sandy woodlands
Trillium discolor	pale yellow trillium	-	S4	S1	Elbert, Hart	rich cove forests, restricted to the Savannah River drainage
Trillium lancifolium	lanceleaf trillium	-	S1	S3	Elbert	rich forests, floodplain forests
Trillium rugelii	southern nodding trillium	-	S2	NA	Abbeville, Anderson	rich woodlands and forests
Viola tripartita var. *glaberrima*	smooth three-parted violet	-	S1	NA	Abbeville	rich woods[f]
Viola tripartita var. *tripartita*	three-parted violet	-	S3	NA	Abbeville, Anderson	rich woods[f]

Source: Species and Communities Known to Occur Within 15 Miles of Middleton Site October 31, 2012 (SCDNR 2012b) and GDNR (2011a)
(a) Federal status: E = endangered, BGEPA = species not protected under the Endangered Species Act of 1973, as amended, but protected under Bald and Golden Eagle Protection Act (FWS 2012a and FWS 2012c).
(b) State rank: S1 = critically imperiled, S2 = imperiled, S3 = vulnerable, S4 = apparently secure, SNR = unranked, SX = presumed extirpated from the state; State protection status: E = state endangered, ST or T = state threatened; NA = not applicable/species not ranked by the state (SCDNR 2012b, GDNR 2011a).
(c) NatureServe Explorer (2010) for animals and Weakley (2010) for plants, unless otherwise indicated.
(d) 64 FR 36454.
(e) FWS (2012c).
(f) Gleason and Cronquist (1991).

Bald eagles are known to nest along Lake Russell (SCDNR 2010g). Unless a nest occurred on or immediately adjacent to the Middleton Shoals site, or the site of the cooling-water reservoir or ancillary facilities, adverse impacts on the bald eagle would not be likely (FWS 2007).

Building Impacts

Building activities for two nuclear units on the Middleton Shoals site would remove about 265 ac of high-quality wooded habitat (Duke 2010g) and disturb about 1.2 ac of wetlands (Duke 2010g, 2011h). Site preparation for the railroad spur, transmission line, and cooling-water pipeline would remove approximately 170 ac of high-quality wooded habitat (Duke 2010g) and disturb about 4.2 ac of wetlands (Duke 2010g, Duke 2011h). Site preparation and inundation of the supplemental cooling-water reservoir would remove about 1800 ac of high-quality wooded habitat (Duke 2010g) and about 174 ac of wetlands (Duke 2010g, Duke 2011h). Site preparation at the Middleton Shoals site and the ancillary facilities, and site preparation and inundation of the cooling-water reservoir, would affect about 402,000 linear ft (approximately 76 mi) of streams (Duke 2010g, 2011h). The riparian corridors of about 362,000 linear ft (approximately 68 mi) of these streams would be permanently inundated by creation of the reservoir. It is uncertain to what extent riparian corridors would be affected along the other 40,000 linear ft (approximately 8 mi) of streams associated with the Middleton Shoals site and ancillary facilities, because this would depend on the need to clear riparian vegetation (e.g., for transmission-line clearance), and the length of stream that would be so affected has not been determined (Duke 2011h). The overall impact of reservoir development on terrestrial resources would be noticeable and permanent.

Two plant species, one State-ranked as critically imperiled and the other as imperiled, could be affected by development of the Middleton Shoals site and associated facilities (Duke 2010g). Other Federally listed and State-ranked terrestrial species that may be present in the project footprint (Table 9-16) also could be affected. Impacts on wildlife at the Middleton Shoals site would be noticeable and similar to those described for the Lee Nuclear Station site in Section 4.3.1.

Operational Impacts

Impacts on terrestrial ecological resources from operation of two new nuclear units at the Middleton Shoals site would be similar to those for the Lee Nuclear Station site as described in Section 5.3.1. There may be minor differences in operational impacts because of factors such as climate, topography, and elevation.

Cumulative Impacts

Overlaying the historic impacts in the Piedmont ecoregion discussed in the Site Description above are the current projects listed in Table 9-14. Projects located within the geographic area of interest include one hydroelectric facility; two natural-gas facilities; two textile plants; a glassware facility; a hazardous waste facility; an automobile tire manufacturing plant; open pits, quarries, and mines; recreational site improvements; public highway, infrastructure, and community facilities improvements; and broadband access improvement. The development of most of these projects has further reduced, fragmented, and degraded natural forests and wetland and riparian habitat and decreased habitat connectivity. Reasonably foreseeable projects and land uses within the geographic area of interest that would affect terrestrial resources include, ongoing silviculture, farming, and agricultural development, and residential and some limited commercial development.

Summary

Impacts on terrestrial ecology resources are estimated based on the information provided by Duke and the review team's independent review. Site preparation and inundation of the cooling-water reservoir, and site preparation and development of the Middleton Shoals site, new transmission-line corridor, water-pipeline corridor, railroad-spur corridor, and road realignment would affect a total of about 2235 ac of high-quality forest habitat, about 179 ac of wetlands, and about 76 mi of riparian corridor. The overall impact of these activities on habitat and wildlife would be noticeable and permanent, particularly in the watershed containing the reservoir. There are 24 Federally listed or State-ranked terrestrial taxa that potentially occur at the Middleton Shoals site and associated facilities that may be affected. There are past, present, and future activities in the geographic area of interest that have affected and would continue to significantly affect habitat and wildlife in ways similar to site preparation and development for the above facilities (i.e., silviculture, farming, and agricultural development, and residential and some limited commercial development).

The review team concludes that the cumulative impacts from past, present, and reasonably foreseeable future actions, including two new nuclear units at the Middleton Shoals site and associated facilities, on baseline conditions for terrestrial ecological resources in the geographic area of interest would be MODERATE. The incremental contribution to these impacts from building and operating two new nuclear units at the Middleton Shoals site would be significant. The impact could be greater if surveys revealed that Federally listed species are present.

9.3.5.4 Aquatic Resources

The following analysis evaluates the impacts from building and operating the proposed new facilities on aquatic ecology resources at the Middleton Shoals site. The analysis also considers past, present, and reasonably foreseeable future actions that affect the aquatic ecological resources, including other Federal and non-Federal projects and the projects listed in Table 9-14. For the analysis of aquatic ecological impacts at the Middleton Shoals site, the geographic area of interest includes the Savannah River Basin from Hartwell Dam downstream to Russell Dam, including the tributary that would be impounded to create a supplemental water reservoir, and waterbodies crossed by the ancillary facilities (one transmission line, a cooling-water pipeline, and a railroad spur). This geographic region is considered the most likely to show impacts on water quality relative to the water-quality criteria for aquatic biota.

In developing this EIS, the review team relied on reconnaissance-level information to perform the alternative site evaluation in accordance with ESRP 9.3 (NRC 2000a). Reconnaissance-level information is data that are readily available from agencies and other public sources such as scientific literature, books, and Internet websites. It can also include information obtained through site visits. To identify aquatic resources at the Middleton Shoals site, the review team relied primarily on the following information:

- a tour of the Middleton Shoals alternative site in April 2008 (NRC 2008d) and a tour of the Middleton Shoals alternative site and supplemental cooling-water reservoir site in August 2010 (NRC 2010c)
- Lee Nuclear Station Joint Application for Activities Affecting Waters of the United States submitted by Duke (2011h) to the USACE
- responses to RAIs provided by Duke (2010g, 2010l)
- FWS Endangered Species Program database for South Carolina (FWS 2012a) and Georgia (FWS 2012c), and South Carolina (SCDNR 2012n, p) and Georgia (GDNR 2011a) Natural Heritage Program county record searches
- correspondence regarding species occurrence from the SCDNR (SCDNR 2012b).

Site Description

The Middleton Shoals site is a wooded greenfield site located on Lake Russell in Anderson County, South Carolina. The site would be located next to Lake Russell approximately 8 mi downstream from Hartwell Dam where the water still has riverine (as opposed to reservoir-like) properties.

The staff visited the Middleton Shoals site in 2008 (NRC 2008d) and the site of the supplemental cooling-water reservoir in 2010 (NRC 2010c). The typical Savannah River shoreline near the proposed location of the cooling-water intake was lined with trees. Banks were generally steep and showed signs of erosion. The tributary that would be impounded to create a supplemental cooling-water reservoir appeared to be wide and turbid, with vegetated sandbars. It was lined with overhanging riparian vegetation, and the surrounding area was forested. The supplemental cooling-water reservoir site watershed is characteristic of small stream watersheds in the Piedmont ecoregion.

Recreationally Important Species

Some of the common sport fish in Lake Russell include Striped Bass, Largemouth Bass, Spotted Bass, Bluegill, Redear Sunfish, and crappie. These fish are common to the Piedmont ecoregion of South Carolina.

Non-Native and Nuisance Species

The Spotted Bass and Asiatic clam (*Corbicula fluminea*) are non-native species found in the Savannah River Basin. Spotted Bass are not native to South Carolina, but have been illegally introduced by anglers into Jocassee, Keowee, Hartwell, and Russell Lakes, where they are a popular sport fish. They may competitively displace Largemouth Bass and appear to be degrading native Redeye Bass (*Micropterus coosae*) populations through competition and hybridization (SCDNR 2008a). Spotted Bass also are correlated with declines in crappie fisheries in some areas.

Federally Listed and State-Ranked Species

Duke provided no field survey information for the Middleton Shoals site. The review team is not aware of any biological field surveys of the area of the Middleton Shoals site, or the site of the cooling-water reservoir, the transmission-line corridor, water-pipeline corridor, or railroad-spur corridor. The presence/absence of Federally listed and State-ranked species in the project footprint cannot be ascertained without site-specific field surveys.

A recent review of the Federally listed and State-ranked aquatic species that may occur in Abbeville and Anderson Counties in South Carolina and in Elbert and Hart Counties in Georgia, near the Middleton Shoals site was performed by the review team. The only Federally listed aquatic species identified was the endangered Carolina heelsplitter (*Lasmigona decorata*), a freshwater mussel. It is listed by FWS as possibly occurring in Abbeville County (FWS 2012a) (Table 9-17).

Eel-grass is the only State-ranked aquatic species (S1– imperiled, Anderson County) listed in Table 9-17 that has been positively identified as occurring within 15 mi of the Middleton Shoals site (SCDNR 2012b). There are two State-protected species within the geographic area of interest: the Carolina heelsplitter (Abbeville County) and the Carolina Darter (Anderson County); they have an assigned State protection status of endangered and threatened, respectively (SCDNR 2012p, n). Georgia State-ranked species with occurrence in Elbert County include two fish, the State-endangered Robust Redhorse and the State-rare Sandbar Shiner (*Notropis scepticus*); two State-threatened crayfish, the lean crayfish (*Cambarus strigosus*) and the Broad River burrowing crayfish (*Distocambarus devexus*), and one freshwater snail, the Savannah pebblesnail (*Somatogyrus tenax*). The Sandbar Shiner also occurs in Hart County (GDNR 2011a). The State ranking (in addition to the Federal listing) provides the only common basis for comparison of numbers of important aquatic species among the Lee, Perkins, Keowee, and Middleton Shoals sites. The Federally listed, State-protected, or State-ranked S1 species are described in more detail below.

Table 9-17. Aquatic Federally Listed and State-Ranked Species in Anderson and Abbeville Counties, South Carolina, and in Elbert and Hart Counties, Georgia

Scientific Name	Common Name	Federal Status[a]	SC State Rank/Protection Status[b]	GA State Rank/Protection Status[b]	Counties of Occurrence
Fish					
Etheostoma collis	Carolina Darter	-	-/T	-	Anderson
Moxostoma robustum	Robust Redhorse	-	-	S1/E	Elbert
Notropis scepticus	Sandbar Shiner	-	-	S2/R	Elbert, Hart
Mollusks					
Lasmigona decorata	Carolina heelsplitter	E	S1/E	-	Abbeville
Somatogyrus tenax	Savannah pebblesnail	-	-	S2S3/-	Elbert
Crustaceans					
Cambarus strigosus	lean crayfish	-	-	S2/T	Elbert
Distocambarus devexus	Broad River burrowing crayfish	-	-	S1/T	Elbert
Aquatic Plant					
Vallisneria americana	eel-grass		S1	-	Anderson

(a) Federal status: E = endangered (FWS 2012a, c).
(b) State rank: S1 = critically imperiled, S2 = imperiled; S3 = vulnerable, S#S# = a numeric range rank used to indicate uncertainty about the exact status of the element; State protection status: E = endangered, T = threatened, R = rare: not listed, but deserving of protection (SCDNR 2012n, p; GDNR 2011a); NatureServe Explorer 2012d).

Carolina Darter

The Carolina Darter in South Carolina is reported in the Yadkin, Pee Dee, and Catawba River drainages but not in the Savannah River Basin (SCDNR 2005). Occurrences are rare, and it is not known whether the species is holding steady or is in decline. The Carolina Darter inhabits small- to moderate-sized streams with low current velocities. It is found most often in habitats with mud or sand substrates, but also has been observed over bedrock. It is not considered stable anywhere within its relatively small range, which extends only from south-central Virginia to north-central South Carolina. Because it has not been recorded in the Savannah River Basin, it is unlikely to be affected by building or operating a nuclear power station at the Middleton Shoals site.

Robust Redhorse

The Robust Redhorse is ranked S1, critically imperiled, in Georgia and is designated as a species of highest conservation priority in South Carolina (SCDNR 2005). It has been found in the Lower Oconee and Middle Savannah Rivers inside the geographic area of interest (Straight et al. 2009). Wild populations exist in this region and successful stocking of the Robust Redhorse in other watersheds has helped to re-establish historical populations. The fish can be difficult to sample because it prefers deep, moderately swift areas near woody debris. Reduced habitat quality and quantity are threats to the species that could potentially be exacerbated through building and operating a new Middleton Shoals nuclear facility and reservoir.

Carolina Heelsplitter

The Federally and South Carolina State-endangered Carolina heelsplitter has been recorded historically from the Savannah River Basin in South Carolina (Bogan and Alderman 2008); little is known about its current status. In South Carolina this species is ranked S1, critically imperiled, and is classified as a species of highest conservation priority by the SCDNR (SCDNR 2005). It has been reported from a wide range of habitats, including creeks, streams, rivers, and ponds. Substrates may include soft mud, sand, muddy sand, and sandy gravel. While it is unlikely the Carolina heelsplitter would be found in the vicinity of the Middleton Shoals site, it is not impossible. If the species is present in the reservoir near the proposed site or on the tributary Duke intends to dam, the species could be significantly and negatively affected. Surveys designed to search for the mussel would need to be conducted to rule out its presence.

Lean Crayfish

The lean crayfish, State-threatened and State-ranked (S2, imperiled) in Georgia, burrows next to streams or in low areas where the water table is near the ground surface. It is known from about 10 locations in the Broad River and Little River systems (Savannah River drainage) in northeast Georgia, including Elbert County (GDNR 2011b). The Little River is a tributary that flows into the J. Strom Thurmond Reservoir. The limited range of the lean crayfish makes it vulnerable to activities that disturb lands near streams and wetlands. While slightly downstream and outside the geographic area of interest, surveys for lean crayfish would be required to determine the species' presence or absence.

Broad River Burrowing Crayfish

The Broad River burrowing crayfish, State-threatened and State-ranked (S1, critically imperiled) in Georgia, also makes burrows next to streams or in low areas where the water table is near the ground surface. They have been captured in temporary pools and ephemeral streams. The species is known only from about seven locations in the Broad River system (Savannah River drainage) in northeastern Georgia, including Elbert County (GDNR 2011b). This system flows into the J. Strom Thurmond Reservoir. The limited range of the Broad River makes it vulnerable to activities that disturb lands near streams and wetlands. While slightly downstream and outside the geographic area of interest, surveys for Broad River burrowing crayfish would be required to determine the species' presence or absence.

Eel-Grass

A member of the tape-grass family (Hydrocharitaceae), eel-grass is found in tidal freshwater marsh where the average annual salinity is less than 0.5 parts per thousand, as well as in clear lakes and in flowing waters of clear streams and small rivers (Nelson 1986; USACE 2012c). Not a true grass, it is a native submerged aquatic vegetation species distributed across much of the United States. The plants are considered a beneficial food source for waterfowl and are sometimes planted for wildlife and fish habitat (USACE 2012c). However, large colonies sometimes interfere with boating and fishing because the long, ribbon-like leaves can reach 3 ft in length and can fill narrow or shallow waterways (USACE 2012c). Eel-grass is State-ranked (S1, critically imperiled) in South Carolina and has been documented in Anderson County within 15 mi of the Middleton Shoals site (SCDNR 2012b). Efforts to establish additional native eel-grass plants to combat the spread of non-native species such as *Hydrilla* have been undertaken in some parts of the State (SCDNR 2012q).

Critical Habitats

No critical habitat has been designated by FWS or NMFS in the vicinity of the Middleton Shoals site.

Building Impacts

Building impacts would likely include impacts on water quality from direct (e.g., dredging, shoreline excavation, clearing, impoundment, etc.) and indirect (e.g., stormwater runoff, sedimentation, etc.) sources. Two new reactor units at the site would require cooling-water intake and discharge systems. A cooling-water intake would be sited near the station and water would be withdrawn from Lake Russell. In addition, Duke would dam a small tributary of the Savannah River to create a supplemental water supply for use during low-flow events. Blowdown would be discharged to Lake Russell. Operation of new facilities at the Middleton Shoals site would require a supplemental cooling-water reservoir (3700 ac [Duke 2010g] with approximately 115,000 ac-ft of storage [Duke 2010l]) and ancillary facilities consisting of a railroad spur, transmission line, cooling-water pipeline (Duke 2010g). The new reactor site, reservoir, and ancillary facilities would affect the creek system and its inhabitants, estimated to beabout402,000 linear ft (approximately 76 mi), which includes the conversion of 362,000 linear ft of stream from a lotic to lentic environment for the supplemental cooling-water reservoir (Duke 2010g). Building activities would also affect a total of 56 ac of open water (7 ac associated with the site, 30 ac associated with the reservoir, and 19 ac associated with ancillary features) (Duke 2011h).

Duke indicated during the April 2008 site visit that one water inlet between two “fingers” of land on the east bank of the Savannah River would be filled to provide a level surface for the station. No areal estimates were provided, but this filling and the resulting loss of aquatic habitat would be sufficient to alter noticeably, but not likely destabilize, important aspects of the resources. All benthic organisms in that area would be lost.

As discussed in Section 9.3.5.1, a new transmission-line corridor would be required to connect the site to the existing transmission-line system. A railroad spur would also be installed to transport building materials to the site. Impacts on aquatic resources from transmission line and railroad-spur installation would be similar to those described for the proposed Lee Nuclear Station in Section 4.3.2.

Operational Impacts

Because a closed-cycle cooling system and supplemental cooling-water reservoir are proposed for the Middleton Shoals site, operational impacts would be expected to be similar to those for the proposed Lee Nuclear Station site as described in Section 5.3.2.

Cumulative Impacts

Current actions in the vicinity that have present and future potential impacts on aquatic ecological resources include operation of energy-production facilities, discharge of water by domestic and industrial NPDES permit holders, withdrawal of water for domestic and industrial purposes, sand and gravel mining, the existence of nature preserves, and ongoing urbanization of the area. They are described in Table 9-14.

The USACE developed Lake Hartwell, Lake Russell, and the associated Hartwell Dam and Richard B. Russell Dam as multipurpose projects. The reservoirs and hydropower generating stations have greatly modified aquatic habitat in the region and will continue to affect aquatic resources while they are operational (USACE 2011b).

Federal regulations prohibit private use of public lands surrounding Lake Russell. At least a 300-ft-wide buffer of public land surrounds the lake. Private shoreline development is not allowed, so Lake Russell has an undeveloped shoreline that provides abundant wildlife habitat (USACE 2011b). Several parks and recreation areas are located within the geographic area of interest, including the 2500-ac Richard B. Russell State Park at the north end of Lake Russell, approximately 5 mi downstream from the Middleton Shoals site, and the 316-ac Calhoun Falls State Recreation Area approximately 12 mi south of the Middleton Shoals site on the easternmost arm of Lake Russell. Other recreation areas 15 to 20 mi downstream of the Middleton Shoals site include the Hart State Outdoor Recreation Area and Bobby Brown Outdoor Recreation Area. These managed areas serve to preserve shoreline habitat and, thereby, limit the potential for future urbanization in those areas.

Reasonably foreseeable projects and water uses within the geographic area of interest that would affect aquatic resources include continued operation of and potential improvements to hydropower generating facilities, discharge of water by domestic and industrial NPDES permit holders, withdrawal of water for domestic and industrial purposes, sand and gravel mining, farming and agricultural development, and residential and possibly some limited commercial development.

Summary

Impacts on aquatic ecology resources are estimated based on the information provided by Duke and the review team's independent review. The most noticeable building activities would affect approximately 402,000 linear ft (approximately 76 mi) of stream habitat and the associated aquatic species. The impacts of building two new nuclear units and a new reservoir on the aquatic ecology of the Savannah River (including Lake Russell) and its tributaries would be clearly noticeable.

There is one Federally and State-listed aquatic endangered species and seven State-ranked or State-listed aquatic species that potentially occur at the Middleton Shoals site and associated facilities that may be affected. Of these species, eel-grass is the only species positively identified as occurring within 15 mi of the Middleton Shoals site (SCDNR 2012b). Surveys to determine the presence or absence of Federally listed and State-ranked species have not been performed in the recent past.

There are past, present, and future activities in the geographic area of interest that have affected and would continue to significantly affect aquatic resources in ways similar to the site preparation and development for the above facilities (i.e., surface and groundwater consumption, thermal and chemical discharges to waterbodies, farming and agriculture development, and residential and some limited commercial development).

The review team concludes that the cumulative impacts from past, present, and reasonably foreseeable future actions, including two new nuclear units at the Middleton Shoals site and associated facilities, on baseline conditions for aquatic ecological resources in the geographic area of interest would be MODERATE. The incremental contribution to these impacts from building and operating two new nuclear units at the Middleton Shoals site would be significant. The impact could be greater if surveys reveal that Federally listed species are present.

9.3.5.5 Socioeconomics

For the analysis of socioeconomic impacts at the Middleton Shoals site, the geographic area of interest is considered to be the 50-mi region centered on the Middleton Shoals site with special consideration of the two-county area of Anderson and Pickens Counties, where the review team expects socioeconomic impacts to be the greatest. In evaluating the socioeconomic impacts of building and operations at the Middleton Shoals site in Anderson County, South Carolina, the review team undertook a reconnaissance survey of the region using readily obtainable data from the ER; the alternative site audit; and Federal, State, and local government agencies. The cumulative impacts analysis also considers other past, present, and reasonably foreseeable future actions that affect the same environmental resources, including other Federal and non-Federal projects and the projects listed in Table 9-14.

Socioeconomic impacts span the issues of physical impacts, demography, economic conditions and taxes, and infrastructure and community services. The impacts of building and operating the new units are discussed below.

Physical Impacts

Many physical impacts of building and operation would be similar regardless of the site. Building activities can cause temporary and localized physical impacts such as noise, odor, vehicle exhaust, vibration, shock from blasting, and dust emissions. The use of public roadways, railways, and waterways would be necessary to transport materials and equipment. Offsite areas that would support building activities (e.g., borrow pits, quarries, and disposal sites) would be expected to be already permitted and operational. Offsite activities would include the development of a supplemental reservoir, railroad spur, transmission-line corridor, cooling-water pipeline, and 7 mi of road realignment.

Potential impacts from station operation include noise, odors, exhausts, thermal emissions, and aesthetics. New units would produce noise from the operation of pumps, cooling towers, transformers, turbines, generators, and switchyard equipment. In addition, traffic at the site would be a source of noise. The review team assumed that same standard noise protection and abatement procedures used for the Lee Nuclear Station site would be used to control noise at the Middleton Shoals site. Commuter traffic would be controlled by speed limits. Good road conditions and appropriate speed limits would minimize the noise level generated by the workforce commuting to the Middleton Shoals site.

The new units at the Middleton Shoals site would likely have standby diesel generators and auxiliary power systems. Permits obtained for these generators would ensure that resultant air emissions comply with applicable regulations. In addition, the generators would be operated on a limited, short-term basis. During normal plant operation, new units would not use a significant quantity of chemicals that could generate odors that exceed odor detection threshold values. Good access roads and appropriate speed limits would minimize the dust generated by the commuting workforce.

Transmission lines would need to be constructed, and though they would be sited to avoid residential areas when possible, they would affect residents along the transmission-line corridors. In addition, land would be cleared to build the supplemental reservoir. Due to the amount of land that would be cleared for building the reactors and associated facilities, the review team concludes that the aesthetic impacts of building two units at the Middleton Shoals site would be noticeable but not destabilizing. Aesthetic impacts from operation would be minimal.

Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that the physical impacts of building and operating two new nuclear units at the Middleton Shoals site would be minimal except for a noticeable physical impact on aesthetics during the building phase.

Demography

The Middleton Shoals site is located in Anderson County, South Carolina (population 183,691), south of the town of Anderson (population 26,566). The rest of Anderson County is rural with significant agricultural activities. To the north of Anderson County is Pickens County, South Carolina (population 117,823), which includes the town of Clemson (population 13,596). Also included in the 50-mi region of the Middleton Shoals site are the large metropolitan areas of Greenville, South Carolina (population 57,821); and Athens, Georgia (population 116,714) (USCB 2010e).

Based on the proposed site location, the regional population distribution and U.S. Census Bureau Journey to Work Data (USCB 2000h), the review team expects the in-migrating population would reside in the two-county area of Anderson and Pickens Counties. The review team realizes that workers may choose to live in other counties within the 50-mi region (e.g., Greenville County), but given the small number of workers and the large population base the review team expects impacts to be *de minimis.* Other counties have relatively small populations and are in close proximity to the site; however, these counties do not have the service and retail centers desired by the in-migrating workforce. Therefore, Anderson and Pickens Counties compose the economic impact area and are the focus of the following analysis.

At the peak of the nuclear power station development, Duke expects the workforce onsite to be approximately 4613 workers. Because the Middleton Shoals site is similar to the proposed Lee Nuclear Station site in geography and urbanization, development of the proposed new units on the Middleton Shoals site would have similar socioeconomic impacts in most respects to building the two units on the Lee Nuclear Station site. Based on the analysis of project impacts presented in Section 4.4.2, of the 4613 peak workers approximately 3191 workers would in-migrate into the region with some workers bringing a family for a total in-migrating population of 4516 people. Considering that the maximum estimation of in-migrating population is less than 1 percent of the existing regional population, the review team expects the demographic impacts of building two units on the Middleton Shoals site would be minimal; however, if the in-migrating population were to locate near the plant (e.g., small rural communities near the site), the impact in those communities could be noticeable but temporary. Once the plant is operational, Duke estimates the workforce to be about 957 workers with an estimated

345 migrating into the region, similar to the proposed Lee Nuclear Station site. Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that the demographic impacts of building and operating two new nuclear units at the Middleton Shoals site would be minimal.

Economic Impacts on the Community

Economy

The local labor force is dominated by manufacturing, government, retail trade, and leisure and hospitality. Some of the top manufacturing employers are Electrolux (household refrigerators), Robert Bosch Corporation (oxygen sensors), Michelin North America (semi-finished rubber products), Hexcel Corporation (woven Kevlar fabrics), and Milliken-Cushman (woven filament fabrics). Agriculture represents 38 percent (176,947 ac) of total Anderson County land area (Duke 2009c). Anderson County's 2009 total labor force is 86,031 with an unemployment rate of 12.6 percent. Pickens County's 2009 labor force was 58,194 with an unemployment rate of 10.8 percent. The 2006 unemployment rates for Anderson and Pickens County were 6.7 percent and 6.2, respectively (BLS 2011a). The significant increase in unemployment rates between 2006 and 2009 is attributed to the recent economic downturn afflicting much of the country.

The wages and salaries of the project workforce would have a multiplier effect that would result in increases in business activity, particularly in the retail and service sectors. This multiplier effect would have a positive impact on the business community and could provide opportunities for new businesses and increased employment opportunities for local residents. The review team expects most indirect jobs created in the region would be allocated to residents in the region. Expenditures made by the indirect workforce would also strengthen the regional economy. Because the review team assumes the economic impacts of the Lee Nuclear Station site (in Section 4.4.3.1 and Section 5.4.3.1) also apply to the Middleton Shoals site, the review team concludes the impact of these new indirect jobs would constitute a small percentage of the total number of jobs in Anderson and Pickens Counties and would have a minimal and beneficial economic impact.

Taxes

If the proposed nuclear plant were located at the Middleton Shoals site, Duke would likely enter into a fee-in-lieu of taxes agreement with Anderson County as allowed by South Carolina State law. This agreement would be similar to the one discussed in Section 5.4.3.2. Without a fee-in-lieu agreement, Duke would pay taxes under the governance of South Carolina State law. This agreement would not go into effect until operations at the Middleton Shoals site have commenced. During the building phase, Duke would continue to pay taxes on the land itself. Anderson County property tax revenues in 2012 were $58 million of the County's $86 million total revenues (Anderson County 2012). Based on the agreement Duke has with Cherokee County in regard to the Lee Nuclear Station, which has an assessment value of 2 percent for the fee-in-lieu-of-taxes payments during the first 20 years, Duke estimates Lee Nuclear Station annual payments would be $11.8 million over 40 years of the license period. If Duke entered into a similar agreement for the Middleton Shoals site, the tax payments would increase Anderson County property tax revenues substantially. Total taxes paid during building activities would have a minimal beneficial impact. The total fee-in-lieu-of-tax payment would be expected to be substantial and beneficial during operations in Anderson County and minimal for the rest of the region.

Infrastructure and Community Services

<u>Traffic</u>

SC 187 and SC 184 converge near the site and connect to SC 81 to the east and SC 181 to the north (to Anderson). Those accessing the site would use SC 184 (Duke 2009c). SC 184 from the Georgia line to SC 81 has an average use of 700 vehicles per day and has room for extra capacity (SCDOT 2008). I-85 runs 5 mi north of Anderson and connects it with the Greenville-Spartanburg area. The two-lane roads near the site would need widening. A railroad spur would need to be built for the transport of materials and equipment to the site, and there is residential area near the site (Duke 2009c). An additional 7.0 mi of road would need to be realigned for inundation of the supplemental pond (Duke 2010g). Given the large number of additional vehicles added to the roads during peak construction, the review team expects traffic-related impacts from building the plant at the Middleton Shoals site would be noticeable on roads near the site. The review team expects traffic-related impacts from operations of a nuclear power station on the Middleton Shoals site to be minimal.

<u>Housing</u>

Based on the analysis in Section 4.4.2, approximately 3191 workers would migrate into the region during the peak employment period of the building phase. Later, approximately 345 operations workers would migrate into the region by the time the plant becomes operational. The 2006-2010 ACS estimate for Anderson County indicated a total housing stock of 83,752 units of which 11,779 were vacant. Pickens County had 50,854 housing units of which approximately 6806 were vacant (USCB 2010e). The review team expects that the in-migrating workforce could be absorbed fairly easily into the existing housing stock in the region and the impact would be minimal.

Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that traffic-related and housing impacts of building two new nuclear units at the Middleton Shoals site would be minimal across the region with the exception of noticeable traffic-related impacts on roads near the site. Because of the much lower number of operations-related workers relative to workers during the building phase, the review team determined traffic-related and housing impacts from operations would be minimal.

Recreation

Recreational activities near the Middleton Shoals site revolve mainly around Sadler's Creek State Recreation Area, 10 mi north of the site and Lake Hartwell, which the site is located on. Lake Hartwell is a hub for recreational activity in the area with 962 mi of shoreline and 80 public boat launch, recreation, and park areas (Duke 2009c). One boat launch is immediately south of the site. The supplemental reservoir would not be available for recreation at any of the alternative sites, or the proposed site. Duke has not indicated that recreational activities near the Middleton Shoals site would be limited during building or operation of a nuclear project. Other recreational areas are far enough offsite not to be affected. Therefore, the review expects impacts on recreation would be minimal for both building and operating two new nuclear units at the Middleton Shoals site.

Public Services

The influx of construction workers and plant operations staff settling in the region could affect local municipal water and water-treatment facilities, police, fire, medical, and other social services in the area. Anderson County has two water suppliers for a total of 48 Mgd and a utilization of 20.1 Mgd (Joint Water System 2013). The 11 wastewater-treatment plants in the county have a capacity of 20.02 Mgd and a current utilization of 10.36 Mgd (Upstate Alliance 2009b). An excess capacity in these systems currently exists sufficient to accommodate a new nuclear plant and the in-migration of workers and their families. The impact on public services would depend on the infrastructure that is developed on the site as well as the location in which the in-migrating workforce chooses to live. The in-migrating workers would represent a small portion of the total population of Anderson and Pickens Counties, and the review team expects they would have a minimal impact on public services.

Education

Anderson County has six school districts with 49 schools and an overall kindergarten through 12th grade enrollment for the 2008-2009 school year of 30,875 students (NCES 2013). Pickens County has 25 schools with a 2010-2011 student enrollment of 16,319. The review team expects, based upon the same underlying assumptions that governed the analysis for the proposed Lee Nuclear Station site, that approximately 400 students would move into the two-county area during the peak employment period for building activities. Assuming equal distribution of those students between counties 200 additional students in each school district would represent a less than 5 percent increase in the student body population. Therefore, the review team determined building a nuclear facility on the Middleton Shoals site would have a minimal impact on education, and that the much smaller operations workforce would also have a minimal impact on education. Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that public services and education impacts of building and operating two new nuclear units at the Middleton Shoals site would be minor.

Summary of Building and Operation Impacts

Physical impacts on workers and the general public include impacts on existing buildings, transportation, aesthetics, noise levels, and air quality. Social and economic impacts span issues of demographics, economy, taxes, infrastructure, and community services. In summary, based on information provided by Duke and the review team's independent evaluation, the review team concludes that the adverse impacts of building and operating a new nuclear plant at the Middleton Shoals site on socioeconomics would be minor for most of the region but could be noticeable, but not destabilizing, in terms of traffic-related and aesthetics impacts during peak project employment. During operations, these impacts are expected to be minor. The impacts on the Anderson County tax base during operations likely would be substantial and beneficial; however, only minor beneficial tax impacts would result in the rest of the region.

Cumulative Impacts

The projects identified in Table 9-14, particularly the future urbanization of the region, have contributed or would contribute to the demographics, economic climate, and community infrastructure of the region and generally result in increased urbanization and industrialization. Because the projects within the review area identified in Table 9-14 would be consistent with applicable land-use plans and control policies, the review team considers the cumulative socioeconomic impacts from the projects to be minimal.

For the analysis of socioeconomic impacts at the Middleton Shoals site, the geographic area of interest is considered to be the 50-mi region centered on the Middleton Shoals site, with special consideration of Anderson and Pickens Counties, where the review team expects socioeconomic impacts to be the greatest.

The Middleton Shoals site is located in eastern Anderson County on the South Carolina and Georgia border. The employment in the area near the Middleton Shoals site is a mixture of manufacturing, government, retail trade, and leisure and hospitality. The nearest large towns are Anderson (population 26,566) and Clemson (population 13,596), which is in Pickens County. Also within the 50-mi region of the Middleton Shoals site are the large metropolitan areas of Greenville, South Carolina (population 57,821)and Athens, Georgia (population 116,714) (USCB 2010e).

The cumulative impact analysis considers other past, present, and reasonably foreseeable future actions that could contribute to the cumulative socioeconomic impacts on a given region, including other Federal and non-Federal projects and the projects listed in Table 9-14. Adverse cumulative impacts would include physical impacts (on workers and the local public, buildings, transportation, and visual aesthetics), demographic impacts, and impacts on local infrastructures and community services (transportation; recreation; housing; water and wastewater facilities; police, fire, and medical services; social services; and education).

Because most projects described in Table 9-14 do not include any significant reasonably foreseeable changes in socioeconomic impacts within 50 mi of the Middleton Shoals site, the review team determined there would be no significant additional cumulative socioeconomic impacts in the region from those activities. Regional planning efforts and associated demographic projections available at a reconnaissance level formed the basis for the review team's assessment of reasonably foreseeable future impacts. Any economic impacts associated with activities listed in Table 9-14 would have been considered as part of the socioeconomic baseline.

The cumulative economic impacts on the community would be beneficial and SMALL with the exception of Anderson County, which would see a LARGE and beneficial cumulative impact on taxes. The cumulative infrastructure and community services impacts would be SMALL with the exception of a MODERATE and adverse cumulative impact on traffic near the Middleton Shoals site. The cumulative physical impacts would be SMALL with the exception of a MODERATE and adverse impact on aesthetics near the site. Building and operating the proposed units at the Middleton Shoals site would be a significant contributor to the LARGE and beneficial economic impact on taxes in Anderson County and also to the MODERATE and adverse impact on infrastructure and community services related to traffic near the site and the MODERATE physical impact on aesthetics. The review team concludes that building two nuclear units at the Middleton Shoals site, in addition to other past, present, and reasonably foreseeable future projects would have SMALL cumulative impacts on demography.

9.3.5.6 Environmental Justice

The 2006–2010 ACS five year population estimates at the census block group level were used to identify minority and low-income populations in the region, and used the same sources and methodology explained in Section 2.6.1 for the proposed site, including a closer look at potential areas of interest using a series of health and physical considerations. There were a total of 859 census block groups within the 50-mi region (USCB 2011a, d). Approximately 155 of these census block groups were classified as aggregate minority populations of interest, and 111 classified as African American populations of interest. There were also 3 census block groups described as Asian, 6"other" race, and 34 with Hispanic populations of interest. Anderson County had 21 census block groups with African American and 28 with aggregate minority populations of interest mainly located within Anderson city limits. There were 118 census block groups classified as having low-income populations of interest in the 50-mi region, of which 13 were in Anderson County, located within and near the Anderson city limits. The review team did not identify any Native American communities or other minority communities with the potential for a disproportionately high and adverse impact due to their unique characteristics or practices. Figure 9-9 shows the geographic locations of the minority populations of interest within the 50-mi radius of the Middleton Shoals site, and Figure 9-10 shows the geographic locations of the low-income populations of interest within the 50-mi radius of the Middleton Shoals site.

Physical impacts from building activities (e.g., noise, fugitive dust, air emissions, traffic) attenuate rapidly with distance, topography, and intervening vegetation. Therefore, the review team determined that, given the distance from the Middleton Shoals site to the nearest populations of interest, there would be no physical impacts with a disproportionately high and adverse effect on minority or low-income populations. For the same reasons, the review team determined the operation of the proposed project at the Middleton Shoals site is also unlikely to have a disproportionately high and adverse impact on minority or low-income populations. A supplemental water reservoir near the site would be needed, which would require acquiring private property from current residents and demolishing houses. New transmission-line corridors would be constructed to link the proposed units to the electric grid. Given the distance between the Middleton Shoals site and the location of minority and low-income populations of interest, impacts from the supplemental water pond and transmission-line corridors would not disproportionately and adversely affect minority or low-income populations. See Sections 2.6, 4.5, and 5.5 for more information about environmental justice criteria and impacts.

In addition to environmental justice impacts from building and operations, the cumulative analysis considers other past, present, and reasonably foreseeable future actions that could contribute to disproportionately high and adverse impacts on minority and low-income populations, including other Federal and non-Federal projects and the projects listed in Table 9-14. For the analysis of environmental justice impacts at the Middleton Shoals site, the geographic area of interest is considered to be the 50-mi region centered on the Middleton Shoals site.

The projects identified in Table 9-14 likely did not or would not contribute to environmental justice impacts of the region. Therefore, based on information provided by Duke and the review team's independent evaluation, the review team concludes there would not be any disproportionately high and adverse environmental justice cumulative impacts from the building and operation of two new nuclear units at the Middleton Shoals site in addition to other past, present, and reasonably foreseeable future projects, and the cumulative environmental justice impacts would be SMALL.

9.3.5.7 Historic and Cultural Resources

The following analysis includes building and operating two new nuclear generating units at the Middleton Shoals site in Anderson County, South Carolina. The analysis also considers other past, present, and reasonably foreseeable future actions that could cause cumulative impacts

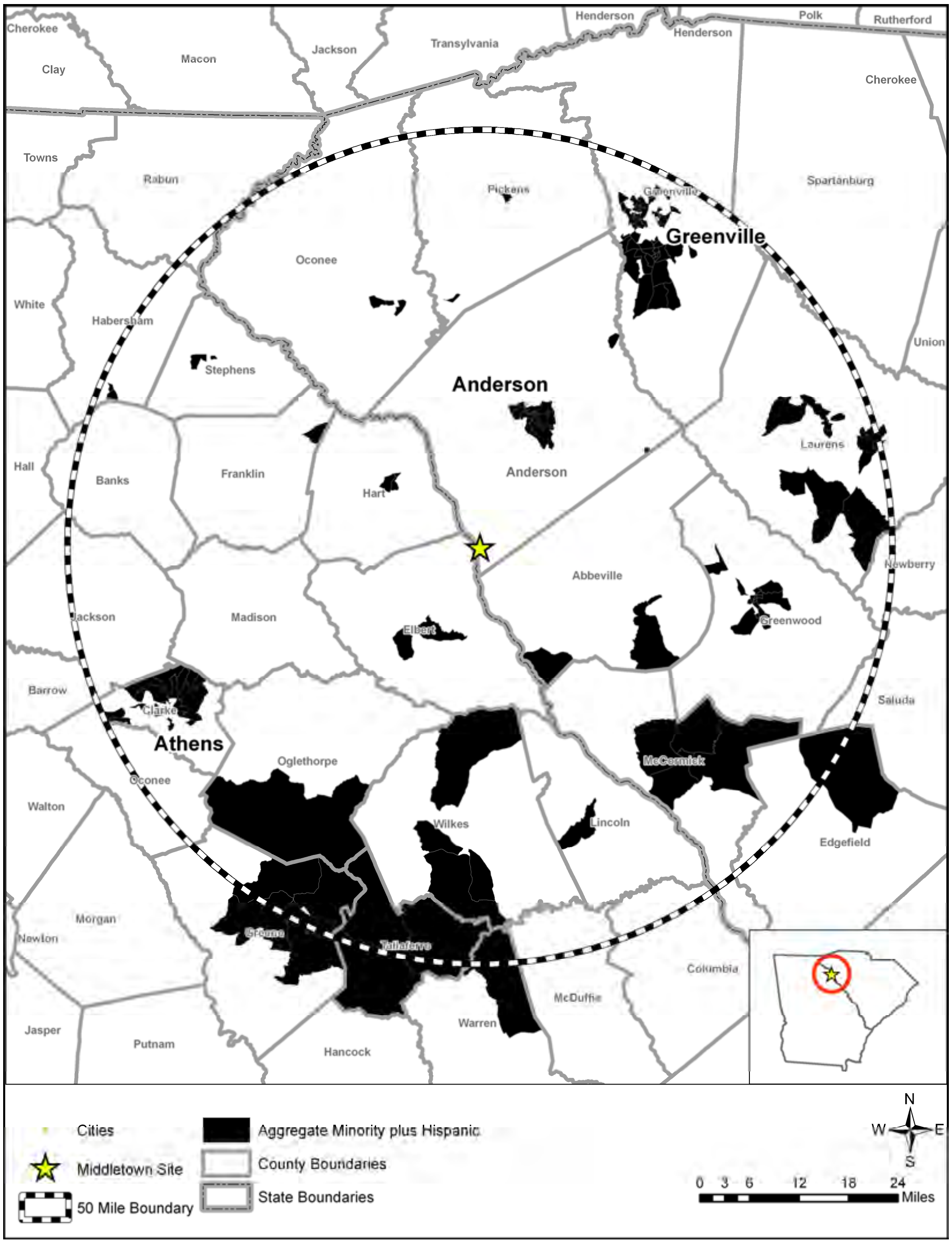

Figure 9-9. Aggregate Minority Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Middleton Shoals Site (USCB 2011a, d)

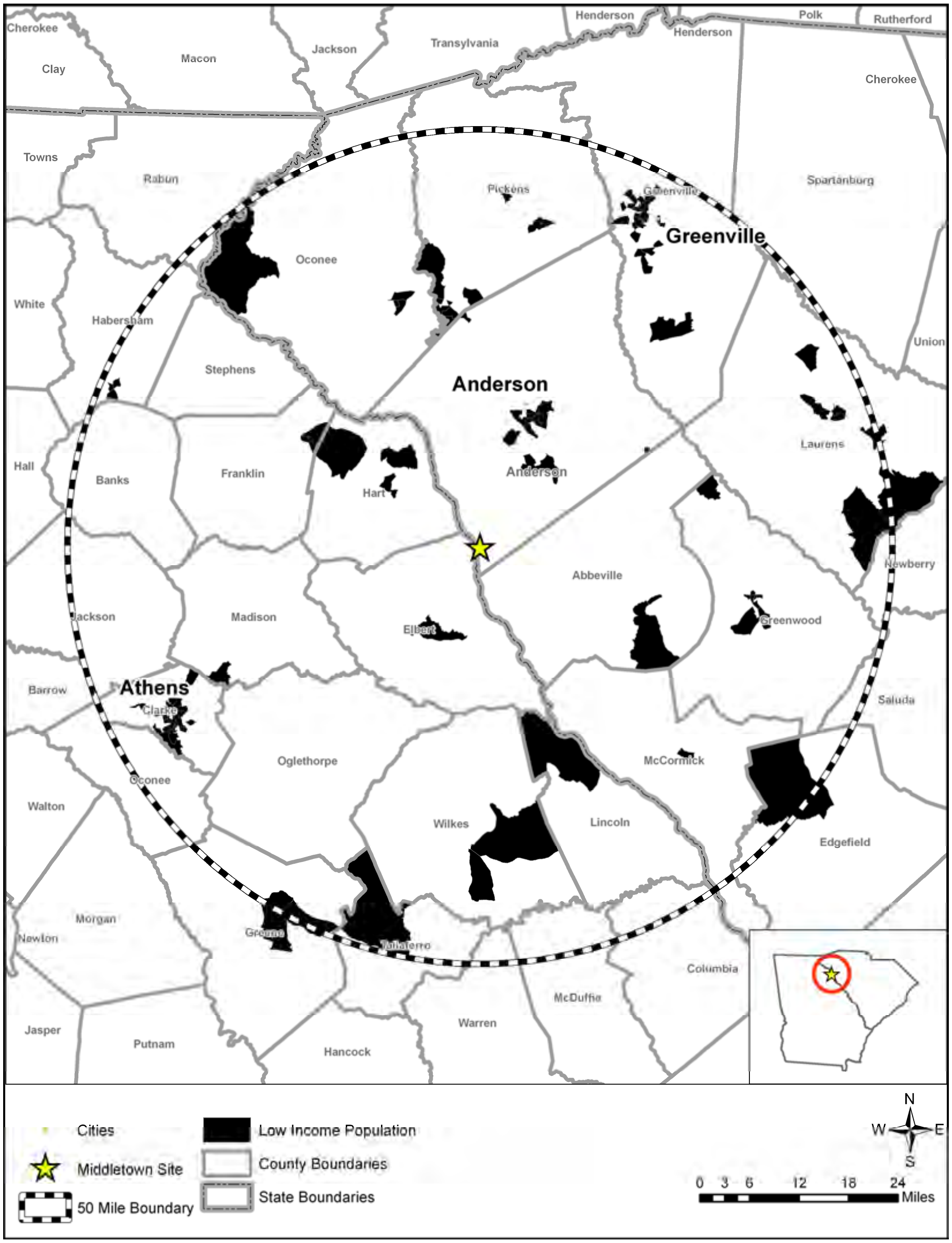

Figure 9-10. Low-Income Populations in Block Groups that Meet the Environmental Justice Selection Criteria at the Middleton Shoals Site (USCB 2011a, d)

on cultural resources, including other Federal and non-Federal projects as listed in Table 9-14. For the analysis of cultural resources impacts at the Middleton Shoals site, the geographic area of interest is considered to be the onsite and offsite direct physical and indirect visual APEs associated with the proposed undertaking. This includes direct physical APEs, defined as the onsite areas directly affected by site development and operation activities as well as offsite areas such as railroad corridors, transmission lines, and new reservoirs. Indirect visual APEs are also included and defined generally as a 1-mi radius buffer around the proposed direct, physical APEs, which encompasses the approximate maximum distance from which tall structures could be seen.

Reconnaissance activities in a cultural resources review have particular meaning. Typically such activities include preliminary field investigations to confirm the presence or absence of historic properties or cultural resources. However, in developing this EIS, the review team relied upon reconnaissance-level information to perform the alternative sites evaluation in accordance with ESRP 9.3 (NRC 2000a). In this context, reconnaissance-level information is data that are readily available from agencies and other public sources. It can also include information obtained through site visits. To identify historic and cultural resources at the Middleton Shoals site, the following information was used:

- the Lee Nuclear Station COL ER (Duke 2009c)
- an August 2010 informal tour of the Middleton Shoals site and visit to the South Carolina Room at the Anderson County Public Library in Anderson, South Carolina (NRC 2010c)
- archival records searches, National Register listings, and cultural resource probability assessments provided by Duke (Duke 2010t)
- the National Park Service’s listing of properties on the National Register (NPS 2011b).

Site Description

Historically, the Middleton Shoals site and vicinity were largely undisturbed and contained intact archaeological resources associated with the past 10,000 years of human settlement. Only limited formal cultural resources investigations have been performed within the study area and no surveys have covered the direct physical APEs considered in this analysis (Duke 2010t).

Duke completed records searches at the South Carolina Department of Archives and History and the South Carolina Institute of Archaeology and Anthropology, and consulted online cultural resource listings through the GDNR to assemble a list of previously recorded cultural resources and historic properties listed or eligible for listing on the National Register that could be affected if the Middleton Shoals site was selected for nuclear plant development (Duke 2010t). According to the search results, no cultural resources investigations have been completed within the onsite direct physical APE for the new units and only limited investigations have been completed within the direct physical APE for the proposed reservoir and in the 1-mi buffer areas that constitute the indirect visual APEs. Even with limited previous surveys in the area, 46 cultural resources have been recorded through surveys and record searches in direct and indirect APEs associated with the Middleton Shoals site. No resources are known to occur in the direct physical APE for the new units, but two National Register-eligible prehistoric archaeological sites and a twentieth-century bridge, which may be eligible for the National Register, are adjacent to the plant site, and eight additional prehistoric archaeological sites are known to occur in the indirect visual APE associated with the proposed new units. Predictive modeling analyses completed by Duke (Duke 2010t) further indicate a high potential for additional archaeological resources to be present in the proposed plant site. One previously recorded prehistoric archaeological site and another twentieth-century bridge with potential for nomination to the National Register are known within the direct APE for the proposed reservoir and 33 additional historic architectural resources have been identified in this indirect APE, including a large historic farmstead complex and a potential historic district at the nearby town of Iva. Simple predictive modeling analyses completed by Duke (Duke 2010t) further indicate that approximately 90 percent of the lands included in the indirect visual APE for the new reservoir exhibit high potential for additional cultural resources and historic properties (i.e., well-drained soils, less than 15 percent slope, outside active floodplains or areas of seasonal or permanent inundation, largely undisturbed).

Building and Operation Impacts

In the event that the Middleton Shoals site was chosen for the proposed project, the review team assumes that Duke would employ the same methods for identifying and assessing impacts on historic properties and cultural resources as those utilized during assessments at the Lee Nuclear Station site and associated developments. This would include field investigations and coordination with the South Carolina SHPO, interested American Indian Tribes, and the public that would be conducted before the initiation of any ground-disturbing activities. The results of these investigations and communications would be used in the site planning process to avoid or mitigate impacts and develop protective measures for any significant resources such as those already listed on the National Register. Duke is committed to this approach for the Lee Nuclear Station site and the review team assumes that Duke would employ the same methods at alternative sites, if chosen for the proposed project (Duke 2009c). Cultural resources sensitivity at the Middleton Shoals site is predicted to be high, based on previous surveys and predictive modeling based on environmental and geographic features that are known attractors for human activity. Initial archival searches and predictive modeling analyses completed by Duke (Duke 2010t)indicate that at a minimum, appropriate mitigations would need to be developed for potential direct impacts on two known cultural resources in the proposed new reservoir site that are potentially eligible for the National Register; three National Register-eligible cultural resources and eight unassessed cultural resources in the 1-mi visual APE buffer around the proposed new units; and at least 33 known historic architectural resources in the indirect visual APE for the proposed reservoir. Additional important historic and cultural resources may also be discovered during new surveys in all APEs. As a result, impacts on cultural resources due to site development and building activities could be noticeable, but not destabilizing with appropriate mitigations implemented.

Impacts on historic and cultural resources from operation of the two new nuclear units at the Middleton Shoals site as well as parallel and related operations at offsite components, such as the new reservoir, railroad line, and transmission-line corridors, would be possible. The review team assumes that Duke Energy's corporate policy for consideration of cultural resources and associated procedures in the event of an unanticipated discovery of cultural resources would apply to operations at the Middleton Shoals site and offsite areas (Duke 2009j). Further, the review team assumes that Duke would negotiate an agreement and associated cultural resources management plan for the Middleton Shoals site with the South Carolina SHPO, the USACE, and interested American Indian Tribes similar to efforts completed for the Lee Nuclear Station site (USACE et al. 2013). Under consistent application of Duke Energy's corporate policy for cultural resources and an agreement and cultural resources management plan specific to the Middleton Shoals site, impacts on cultural resources due to operations would be negligible.

Cumulative Impacts

The geographic area of interest for cumulative impacts on historic and cultural resources at the Middleton Shoals site corresponds to the onsite and offsite direct (physical) and indirect (visual) APEs defined for the site. Past actions in the geographic area of interest that could have affected historic and cultural resources in a manner similar to those associated with the building and operation of the two new units and other project components include rural agricultural and limited residential development. Table 9-14 also lists future projects that may similarly affect historic and cultural resources and contribute to cumulative impacts in the geographic area of interest, including transportation improvements associated with the South Carolina Strategic Corridor System Plan (SCDOT 2009b) and new developments associated with future urbanization in the region. These projects could affect historic and cultural resources through ground-disturbance or visual impacts on historic settings or architectural properties, but the inclusion of Federal funding in most of these efforts should ensure appropriate mitigation.

Cultural resources are non-renewable; therefore, the impact of destruction of cultural resources is cumulative. Based on the information provided by Duke and the review team's independent evaluation, the review team concludes that the cumulative impacts from past agricultural and residential development, future State and Federal transportation improvements, future urbanization of the area, and the building and operation of two new nuclear units on the Middleton Shoals site would be MODERATE. The incremental contribution of building and operating the two new units and associated plant components would be significant to these cumulative impacts given the 46 historic properties and cultural resources known to exist in onsite and offsite indirect visual APEs and the high probability for additional cultural resource discoveries in all APEs and the geographic area of interest.

9.3.5.8 Air Quality

The following impact analysis includes impacts on air quality from building activities and operations. The analysis also considers other past, present, and reasonably foreseeable future actions that affect air quality, including other Federal and non-Federal projects listed in Table 9-14. The air-quality impacts related to building and operating a nuclear facility at the Middleton Shoals site would be similar to those at the Lee Nuclear Station site.

The Middleton Shoals site is located in Anderson County, South Carolina, which is part of the Greenville-Spartanburg Intrastate Air Quality Control Region (40 CFR 81.106). The geographic area of interest for this resource area is the 50-mi radius of the site, which includes Anderson County. Designations of attainment or nonattainment are made on a county-by-county basis. Anderson County is designated as unclassifiable or in attainment for all criteria pollutants for which NAAQS have been established (40 CFR 81.341). Criteria pollutants include ozone, PM, CO, No_x, SO_2, and lead. Anderson County came into attainment with the 8-hour ozone standard on April 15, 2008, and is, therefore, considered a maintenance area for ozone (40 CFR 81.341). An applicability analysis would need to be performed per 40 CFR Part 93 Subpart B to determine if a general conformity determination is needed. The closest Class 1 Federal Area (i.e., Shining Rock Wilderness Area, North Carolina) is more than 50 mi from the Middleton Shoals site and it would, therefore, not likely be affected by minor source emissions from the site. Class I areas are considered of special national or regional natural, scenic, recreational, or historic value and are afforded additional air quality protection.

As described in Section 4.7, emissions of criteria pollutants from building the two units are expected to be temporary and limited in magnitude. As discussed in Section 5.7, emissions of criteria pollutants from operations would be primarily from the intermittent use of standby diesel generators and pumps. Given the temporary air emissions from construction and intermittent air emissions from operation, and that Anderson County is currently designated as being unclassified or in attainment for criteria pollutants, the review team concludes the impacts from building and operating two new units on air quality would be minimal.

Cumulative impacts on air quality resources are estimated based on the information provided by Duke and the review team's independent evaluation. Of the projects listed in Table 9-14, two energy-related projects (the John Rainey Generating Station and the Anderson Regional Landfill Generating Station) are considered major sources of NAAQS criteria pollutants in Anderson County. In addition, several industrial facilities listed in Table 9-14 are major sources of NAAQS criteria pollutants in Anderson County. Other past, present, and reasonably foreseeable activities exist in the geographic area of interest that could affect air quality resources. The impacts on criteria pollutants in Anderson County from emissions of effluents from the

Middleton Shoals site and nearby major sources, and other projects and activities within 50 mi of the region would not be noticeable.

The greenhouse gas emissions from two nuclear units at the Middleton Shoals site would be the same as those analyzed in Chapters 4, 5, and 6 for the Lee Nuclear Station site. The cumulative impacts of greenhouse gas emissions related to nuclear power are discussed in Section 7.6. The impacts of the emissions are not sensitive to location of the source. Consequently, the conclusion in Section 7.6—national and worldwide impacts of greenhouse gas emissions are noticeable but not destabilizing—is applicable to two AP1000 reactors located at the Middleton Shoals site.

The review team concludes that the cumulative impacts, including those from other past, present, and reasonably foreseeable future actions on air quality resources in the geographic area of interest would be SMALL for criteria pollutants and MODERATE for greenhouse gas emissions. The incremental contribution of impacts on air quality resources from building and operating two units at the Middleton Shoals site would not be significant to the MODERATE air-quality impact from greenhouse gas emissions.

9.3.5.9 Nonradiological Health Impacts

The following analysis considers nonradiological health impacts from building and operating two new nuclear units at the Middleton Shoals alternative site. Impacts on nonradiological health at the Middleton Shoals site are estimated based on the information provided by Duke and the review team's independent evaluation. The analysis also includes past, present, and reasonably foreseeable future actions that could contribute to the cumulative nonradiological health impacts on site workers and the public, including other Federal and non-Federal projects and the projects listed in Table 9-14. For the analysis of nonradiological health impacts at the Middleton Shoals site, the geographic area of interest is considered to be the 6-mi vicinity centered on the Middleton Shoals site and the associated transmission-line corridors based on the localized nature of nonradiological health impacts.

Building activities with the potential to affect the health of members of the public and workers at the Middleton Shoals site include exposure to dust, vehicle exhaust, and emissions from construction equipment; noise; occupational injuries; and the transport of construction materials and personnel to and from the site. The operation-related activities that may affect the health of members of the public and workers include exposure to etiological agents, noise, occupational injuries, EMFs, and impacts from the transport of workers to and from the site.

Building Impacts

Nonradiological health impacts on construction workers and members of the public from building two new nuclear units at the Middleton Shoals alternative site would be similar to those evaluated in Section 4.8. Duke would comply with applicable Federal and State regulations on air quality and noise during the site-preparation and building phase. The frequency of construction worker accidents would not be expected to be different from the frequency of accidents estimated for the proposed Lee Nuclear Station site.

Section 4.8.3 concludes that the impacts on nonradiological health from the transport of construction workers and materials to and from the Lee Nuclear Station site would be minimal. Impacts at the Middleton Shoals site would be about 31 percent lower than the estimated impacts for the Lee Nuclear Station site. This difference is due to differences in the average State-specific fatality rates used for construction workers (transportation calculations use the closest population center for transportation data, which is located in Georgia). Impacts on nonradiological health related to transportation at the Middleton Shoals alternative site would be minimal.

The Middleton Shoals site is a greenfield site located in a rural area and will require extensive rough grading (Duke 2009c). Impacts from building activities, including the associated transmission lines and a 3700-ac supplemental cooling-water reservoir at the Middleton Shoals site would be minimal.

Operational Impacts

Nonradiological health impacts from operation of two new nuclear units on site workers and members of the public at the Middleton Shoals site would be similar to those evaluated in Section 5.8 for the proposed Lee Nuclear Station site. Occupational health impacts on workers (e.g., falls, electric shock, or exposure to other hazards) at the Middleton Shoals site would likely be the same as those evaluated for workers at the Lee Nuclear Station site. Russell Reservoir would be the source of cooling water and the recipient of thermal discharge for two proposed nuclear units at the Middleton Shoals site. The Savannah River downstream of the alternative site location is listed as impaired for mercury, fecal coliform, and turbidity (EPA 2010am). Due to pre-existing water-quality issues, exposure to the public from waterborne etiological agents at the Middleton Shoals site could be more likely than at the proposed or other alternative sites. Operation of new nuclear units at the Middleton Shoals site could lead to an increase in waterborne diseases in the vicinity. Noise and EMF exposure would be monitored and controlled in accordance with applicable OSHA regulations. Effects of EMF on human health would be controlled and minimized by conformance with NESC criteria (IEEE 2012).

Impacts from transportation of operations workers to and from the Middleton Shoals site would result in about a 6 percent increase in traffic fatalities in Anderson County. This difference in this increase of fatalities from that at the Lee Nuclear Station site is due to the difference in the average county-specific baseline annual fatalities (between Cherokee and Anderson County). Because this increase is small relative to the baseline traffic fatalities (i.e., before the new units are constructed) in Anderson County, the review team concludes that the impacts of transporting construction materials and personnel to the Middleton Shoals site would be minimal. The review team concludes that nonradiological health impacts on site workers and public from the operation of the two nuclear units at the Middleton Shoals alternative site would be minimal.

Cumulative Impacts

The past development and current operation of the Rainey Generating Station, a 1095-MW, six-unit natural-gas-fired peaking power plant, located approximately 6 mi north-northwest of the Middleton Shoals site, could contribute to cumulative nonradiological health impacts. Past nonradiological health impacts would have been localized and temporary, and current impacts from the Rainey Generating Station could include emissions from station operation and discharge of thermal effluents to the Savannah River. Rainey Generating Station holds current air permits and an NPDES major industrial permit subject to SCDHEC regulation, and would be expected to comply with the limitations in those permits (EPA 2010am). Operation of the Rainey Generating Station would not contribute significantly to cumulative nonradiological health impacts in the vicinity of the Middleton Shoals site.

There are no proposed future actions that would have nonradiological health impacts similar to development at the Middleton Shoals site. However, transmission-line creation and/or upgrading in the vicinity of the Middleton Shoals site and future urbanization would be expected to occur.

The review team is also aware of the potential climate changes that could affect human health—a recent compilation of the state of knowledge in this area (GCRP 2009) has been considered in the preparation of this EIS. Projected changes in the climate of the southeast during the life of the proposed nuclear station include a small increase in average temperature and a decrease in precipitation in winter, spring, and summer, and a small increase in precipitation in fall (GCRP 2009). This may result in a small, gradual increase in river water temperature, which may alter the presence of microorganisms and parasites in the Savannah River/Russell Reservoir. While the changes that are attributed to climate change in these studies (GCRP 2009) may not be insignificant on a national or global level, the review team did not identify anything that would alter its conclusion regarding the presence of etiological agents or change the incidence of waterborne diseases in the vicinity of the Middleton Shoals site. The review team concludes that the nonradiological health cumulative impacts from building two new nuclear units, associated transmission lines, and offsite reservoir at the Middleton Shoals site would be minimal.

Summary

Nonradiological health impacts from building and operating two new units at the Middleton Shoals site are estimated based on the information provided by Duke and the review team's independent evaluation. The review team concludes that nonradiological health impacts on construction workers and the public resulting from the building of two new nuclear units, associated transmission lines, and offsite reservoir at the Middleton Shoals site would be minimal. The review team also expects that the occupational health impacts on members of the public and operations workers from two new nuclear units at the Middleton Shoals site would be minimal. Finally, the review team concludes that cumulative nonradiological health impacts from related past, present, and future actions in the geographic area of interest would be SMALL. As discussed in Section 5.8, the NRC staff is not able to come to a conclusion on the chronic impacts of EMFs.

9.3.5.10 Radiological Health Impacts of Normal Operations

The following impact analysis includes radiological health impacts on the public and workers from building activities and operations for two nuclear units at the Middleton Shoals alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that could have radiological health impacts, including other Federal and non-Federal projects and the projects listed in Table 9-14. As described in Section 9.3.5, the Middleton Shoals site is a greenfield site; there are currently no nuclear facilities on the site. The geographic area of interest is the area within a 50-mi radius of the Middleton Shoals site. The only facility potentially affecting radiological health within this geographic area of interest is the existing Oconee Nuclear Station, located about 37 mi north of the Middleton Shoals site. In addition, medical, industrial, and research facilities that use radioactive material are likely to be within 50 mi of the Middleton Shoals site.

The radiological impacts of building and operating the proposed two AP1000 units at the Middleton Shoals site include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways would result in low doses to people and biota offsite that would be well below regulatory limits. The impacts are expected to be similar to those at the Lee Nuclear Station site.

The radiological impacts of Oconee Units 1, 2, and 3 include doses from direct radiation and liquid and gaseous radioactive effluents. These pathways result in low doses to people and biota offsite that are well below regulatory limits as demonstrated by the ongoing radiological environmental monitoring program conducted around Oconee Nuclear Station. The NRC staff concludes that the dose from direct radiation and effluents from medical, industrial, and research facilities that use radioactive material would be an insignificant contribution to the cumulative impact around the Middleton Shoals site. This conclusion is based on data from the radiological environmental monitoring programs conducted around currently operating nuclear power plants. Based on the information provided by Duke and the NRC staff's independent analysis, the NRC staff concludes that the cumulative radiological impacts from building and operating the two proposed AP1000 units and other existing and planned projects and actions in the geographic area of interest around the Middleton Shoals site would be SMALL.

9.3.5.11 Postulated Accidents

The following impact analysis includes radiological impacts from postulated accidents from the operation of two nuclear units at the Middleton Shoals alternative site. The analysis also considers other past, present, and reasonably foreseeable future actions that affect radiological health from postulated accidents, including other Federal and non-Federal projects and the projects listed in Table 9-14. As described in Section 9.3.5, the Middleton Shoals site is a greenfield site; there are currently no nuclear facilities at the site. The geographic area of interest considers all existing and proposed nuclear power plants that have the potential to increase theprobability-weighted consequences (i.e., risks) from a severe accident at any location within 50 mi of the Middleton Shoals alternative site. Facilities potentially affecting radiological accident risk within this geographic area of interest are the existing Oconee Nuclear Station Units 1, 2, and 3, VEGP Units 1 and 2, and VCSNS Unit 1. Two additional units are also under construction at both the VEGP and VCSNS sites. Other facilities potentially affecting radiological accident risk within this geographic area of interest include the DOE SRS and the Mixed Oxide (MOX) Fuel Fabrication Facility at the SRS.

As described in Section 5.11.1, the NRC staff concludes that the environmental consequences of DBAs at the Lee Nuclear Station site would be minimal for AP1000 reactors. DBAs are addressed specifically to demonstrate that a reactor design is robust enough to meet NRC safety criteria. The AP1000 design is independent of site conditions, and the meteorology of the Middleton Shoals alternative and Lee Nuclear Station sites are similar; therefore, the NRC staff concludes that the environmental consequences of DBAs at the Middleton Shoals alternative site would be minimal.

Assuming the meteorology, population distribution, and land use for the Middleton Shoals alternative site are similar to the proposed Lee Nuclear Station site, risks from a severe accident for an AP1000 reactor located at the Middleton Shoals alternative site are expected to be similar to those analyzed for the proposed Lee Nuclear Station site. The risks for the proposed Lee Nuclear Station site are presented in Tables 5-14 and 5-15 and are well below the median value for current-generation reactors. In addition, as discussed in Section 5.11.2, estimates of average individual early fatality and latent cancer fatality risks are well below the Commission's safety goals (51 FR 30028). For existing plants within the geographic area of interest (Oconee Nuclear Station Units 1, 2, and 3; VEGP Units 1 and 2; and VCSNS Unit 1), the Commission has determined that the probability-weighted consequences of severe accidents are small (10 CFR Part 51, Appendix B, Table B-1). Finally, according to the EISs for the Vogtle ESP (NRC 2008h) and the VCSNS Units 2 and 3 COLs (NRC 2011f) the risks from the units under construction would also be well below risks for current-generation reactors and would meet the Commission's safety goals.

There are no reactors currently operating at DOE's SRS; however, there is some severe accident risk associated with the spent nuclear fuel and other high-level radioactive wastes that may be processed or stored at SRS. The severe accident risks associated with stored spent fuel at operating nuclear power plants are lower than the risks for severe accidents involving the reactor core. Likewise, the severe accident risks associated any spent reactor fuel or other high-level radioactive waste processed or stored at SRS would be lower than the risks for severe accidents involving the reactor core. There is no irradiated fuel at the MOX Fuel Fabrication Facility at SRS, and this facility is designed to prevent inadvertent criticalities. Other facilities at SRS may contain substantial amounts of radioactive material, but there is no credible severe accident risk like there is for an operating reactor. Therefore, the additional risk from these facilities is not significant in the evaluation of the cumulative severe accident risk for a nuclear power plant at the Middleton Shoals alternative site. On this basis, the NRC staff concludes that the cumulative risks from severe accidents at any location within 50 mi of the Middleton Shoals alternative site would be SMALL.

9.3.6 Comparison of the Impacts of the Proposed Action and the Alternative Sites

This section summarizes the review team's characterization of the cumulative impacts related to locating a two-unit AP1000 nuclear power facility at the proposed Lee Nuclear Station site and at each alternative site. The three sites selected for detailed review as part of the alternative sites environmental analysis included the Perkins site located in Davie County, North Carolina; the Keowee site located in Oconee County, South Carolina; and the Middleton Shoals site located in Anderson County, South Carolina. Comparisons are made between the proposed site and alternatives to evaluate whether one of the alternative sites is environmentally preferable to the proposed site. The NRC's determination is independent of the USACE's determination under the 404 Guidelines of whether the Lee Nuclear Station site is the least environmentally damaging practical alternative (LEDPA). The USACE will conclude its analysis of both offsite and onsite alternatives in its Record of Decision. The USACE alternatives evaluation is discussed in Section 9.5. The need to compare the proposed site with alternative sites arises from the requirement in NEPA Section 102(2)(C)(iii) (42 U.S.C. 4332) that EISs include an analysis of alternatives to the proposed action. The NRC criterion to be used in assessing whether a proposed site is to be rejected in favor of an alternative site is based on whether the alternative site is "obviously superior" to the site proposed by the applicant (Public Service Company of New Hampshire 1977). An alternative site is "obviously superior" to the proposed site if it is "clearly and substantially" superior to the proposed site (Rochester Gas & Electric Corp. 1978). The standard of obviously superior "...is designed to guarantee that a proposed site will not be rejected in favor of an alternate unless, on the basis of appropriate study, the Commission can be confident that such action is called for" (New England Coalition on Nuclear Pollution 1978).

The "obviously superior" test is appropriate for two reasons. First, the analysis performed by the NRC in evaluating alternative sites is necessarily imprecise. Key factors considered in the alternative site analysis, such as population distribution and density, hydrology, air quality, aquatic and terrestrial ecological resources, aesthetics, land use, and socioeconomics are difficult to quantify in common metrics. Given this difficulty, any evaluation of a particular site must have a wide range of uncertainty. Second, the applicant's proposed site has been analyzed in detail, with the expectation that most of the adverse environmental impacts associated with the site have been identified. The alternative sites have not undergone a comparable level of detailed study. For these reasons, a proposed site may not be rejected in favor of an alternative site when the alternative site is marginally better than the proposed site, but only when it is obviously superior (Rochester Gas & Electric Corp. 1978). NEPA does not require that a nuclear plant be constructed on the single best site for environmental purposes. Rather, "...all that NEPA requires is that alternative sites be considered and that the effects on the environment of building the plant at the alternative sites be carefully studied and factored into the ultimate decision" (New England Coalition on Nuclear Pollution 1978).

Section 9.3.6.1 discusses the process the review team used to compare cumulative impacts of the alternative sites to the proposed Lee Nuclear Station site and provides the final cumulative impact for each resource category. Cumulative impact levels from Chapter 7 (for the Lee Nuclear Station), and the three alternative sites (from Sections 9.3.3 through 9.3.5) are listed in Table 9-18. Section 9.3.6.2 discusses the cumulative impacts of the proposed project located at the Lee Nuclear Station site and at the alternative sites as they relate to a determination of environmental preference or obvious superiority.

Table 9-18. Comparison of Cumulative Impacts at the Lee Nuclear Station Site and Alternative Sites

Resource Category	Lee Nuclear Station[(a)]	Perkins	Keowee	Middleton Shoals
Land Use	MODERATE	MODERATE	MODERATE	MODERATE
Water-Related				
Surface-water use	MODERATE	MODERATE	MODERATE	MODERATE
Groundwater use	SMALL	SMALL	SMALL	SMALL
Surface-water quality	SMALL	MODERATE	MODERATE	MODERATE
Groundwater quality	SMALL	SMALL	SMALL	SMALL
Ecology				
Terrestrial and wetland ecosystems	MODERATE	MODERATE	MODERATE	MODERATE
Aquatic ecosystems	MODERATE	MODERATE	MODERATE	MODERATE
Socioeconomics				
Physical impacts	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Demography	SMALL	SMALL	SMALL	SMALL

Table 9-18. (contd)

Resource Category	Lee Nuclear Station[(a)]	Perkins	Keowee	Middleton Shoals
Economic impacts on the community	SMALL to LARGE (beneficial)	SMALL to LARGE (beneficial)	SMALL to LARGE (beneficial)	SMALL to LARGE (beneficial)
Infrastructure and community services	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Environmental Justice	SMALL	SMALL	SMALL	SMALL
Historic and Cultural Resources	MODERATE	MODERATE	MODERATE	MODERATE
Air Quality				
Criteria pollutants	SMALL	SMALL	SMALL	SMALL
Greenhouse gas emissions	MODERATE	MODERATE	MODERATE	MODERATE
Nonradiological Health	SMALL	SMALL	SMALL	SMALL
Radiological Health	SMALL	SMALL	SMALL	SMALL
Postulated Accidents	SMALL	SMALL	SMALL	SMALL

(a) From Table 7-4.

9.3.6.1 Comparison of Cumulative Impacts at the Proposed and Alternative Sites

The following section summarizes the review team's independent assessment of the proposed and alternative sites. The team characterized the expected cumulative environmental impacts of building and operating new units at the Lee Nuclear Station site and alternative sites; these impacts are summarized by category in Table 9-18. Full explanations for the specific impact characterizations are provided cumulatively in Chapter 7 for the proposed site and in Sections 9.3.3, 9.3.4, and 9.3.5 for each of the alternative sites. The review team's impact category levels are based on professional judgment, experience, and consideration of controls likely to be imposed under Federal, State, or local permits that would not be acquired until after the review of a COL application is underway. The considerations and assumptions were similarly applied at each of the alternative sites to provide a common basis for comparison. In the following discussion, the review team compares the impact levels between the proposed site and each alternative site.

The cumulative environmental impact areas listed in the table have been evaluated using the NRC's three-level standard of significance: SMALL, MODERATE, or LARGE. These levels were developed using CEQ guidelines and are set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize important attributes of the resource.

LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

9.3.6.2 Environmentally Preferable Sites

The cumulative impacts of building and operating two new nuclear units at the Lee Nuclear Station site and at each alternative site are SMALL for several impact categories. The resource categories for which the impact level at an alternative site would be the same as the proposed site would not contribute to the determination that the alternative site is environmentally preferable to the proposed site. Therefore, these categories are not discussed further in determining whether an alternate site is environmentally preferable to the proposed site. Where there is a range of impacts for a resource, the upper range of the resource is used for the comparison. In addition, for those cases in which the cumulative impacts for a resource would be greater than SMALL, consideration is given to those cases in which the impacts of the project at the specific site would not make a significant contribution to the cumulative impact level.

As shown in Table 9-18, there are only minor differences in impacts among the sites. All of the sites are in rural areas with similar physiographic, ecological, cultural resource, and socioeconomic characteristics. Use of any of the sites would require building one or more large, supplemental cooling-water reservoirs that would inundate stream valleys. Use of the cooling-water reservoirs reduces the impacts on surface water use at each site.

Table 9-18 indicates that the cumulative impacts on surface-water quality for the Lee Nuclear Station site are SMALL, and that the impact at each of the alternative sites is MODERATE. However, for the alternative sites, building and operating two nuclear units is not a significant contributor to the MODERATE impact. Therefore, surface-water-quality impacts do not serve to differentiate between the sites.

The review team concludes that the alternative sites and the Lee Nuclear Station site are generally comparable, and it would be difficult to state that one site is preferable to another from an environmental perspective. In such a case, the proposed site prevails because none of the alternatives are clearly environmentally preferable.

9.3.6.3 Obviously Superior Sites

None of the alternative sites was determined to be environmentally preferable to the Lee Nuclear Station site. Therefore, none of the alternative sites is obviously superior to the Lee Nuclear Station site.

9.4 System Design Alternatives

The review team considered a variety of heat-dissipation systems and circulating-water system (CWS) alternatives. While other heat-dissipation systems and water systems are part of a nuclear power plant, the largest and most capable of causing environmental impacts is the CWS that cools and condenses the steam for the turbine generator. Other water systems, such as the service-water system, are much smaller than the CWS. As a result, the review team only considers alternative heat-dissipation and water-treatment systems for the CWS. The proposed CWS for the Lee Nuclear Station Units 1 and 2 is a closed-cycle system that uses mechanical draft cooling towers for heat dissipation (Duke 2009c). The proposed system is discussed in detail in Chapter 3.

9.4.1 Heat-Dissipation Systems

About two-thirds of the heat from a commercial nuclear reactor is rejected as heat to the environment. The remaining one-third of the reactor-generated heat is converted into electricity. Normal heat-sink cooling systems transfer the rejected heat load into the atmosphere and/or nearby waterbodies, primarily as latent heat exchange (evaporating water) or sensible heat exchange (warmer air or water). Different heat-dissipation systems rely on different exchange processes. The following sections describe alternative heat-dissipation systems considered by the review team for the Lee Nuclear Station Units 1 and 2.

In its ER, Duke considered a range of CWS heat-dissipation systems, including a once-through cooling system and several closed-cycle cooling systems. In addition to the closed-cycle mechanical draft cooling towers selected, Duke considered natural draft cooling towers, once-through cooling into the Broad River, cooling ponds, spray ponds, dry cooling towers, and a combination wet-dry hybrid cooling-tower system (Duke 2009c). Duke also considered rectangular mechanical draft cooling towers in addition to the circular design chosen for the site (Duke 2009c). In addition, the review team considered mechanical draft cooling towers with plume abatement.

9.4.1.1 Wet Natural Draft Cooling Towers

Wet natural draft cooling towers, which use about the same amount of water as the proposed mechanical draft cooling towers, induce airflow up through large (600 ft tall and 400 ft in diameter) towers by cascading warm water downward in the lower portion of the cooling tower. As heat transfers from the water to the air in the tower, the air becomes more buoyant and rises. This buoyant circulation induces more air to enter the tower through its open base. The environmental aspects of wet natural draft cooling towers and mechanical draft cooling towers are very similar (Duke 2009c). Because both rely on evaporation to dissipate the heat, water use is similar between natural and mechanical draft cooling towers; therefore, intake and discharge effects on aquatic biota would be similar. Notable differences are that natural draft cooling towers can be seen from a greater distance and that the additional height increases the potential for avian and bat collisions (NRC 2013a). The large size of the natural draft cooling towers could have a greater visual and aesthetic impact than mechanical draft cooling towers. Because the Lee Nuclear Station site is located in a remote area, the aesthetic impacts of wet natural draft towers would be similar because visual impacts would be dominated by the plume rather than the tower. The likelihood of bird collision impacts is somewhat lower for the proposed mechanical draft cooling towers than for natural draft cooling towers. Also, the energy savings from using natural draft versus mechanical draft cooling towers are minimal. Therefore, the review team determined that wet natural draft cooling towers would not be an environmentally preferable alternative for the Lee Nuclear Station site.

9.4.1.2 Once-Through Cooling

Once-through cooling systems withdraw water from the source waterbody and return virtually the same volume of water to the receiving waterbody at an elevated temperature. Typically the source waterbody and the receiving waterbody are the same body, and the intake and discharge structures are separated to limit recirculation. While there is essentially no consumptive use of water in a once-through heat-dissipation system, the elevated temperature of the receiving waterbody would result in some induced evaporative loss that decreases the net water supply. The elevated temperature can also adversely affect the biota of the receiving waterbody. The large intake flows would result in impingement and entrainment losses. Based on recent changes to implementation plans to meet Section 316(b) of the Clean Water Act, the review team has determined that once-through cooling systems for new nuclear reactors are unlikely to be permitted in the future, except in rare and unique situations.

If proposed Lee Nuclear Station Units 1 and 2 were to use once-through cooling with two AP1000 reactors, the review team determined that the water-supply needs for the two units would be approximately 1,700,000 gpm (NRC 2011f). Duke has determined that the needed volume of water cannot be practically supplied by the Broad River (Duke 2009c). For this reason, in addition to the Clean Water Act 316(b) considerations, the review team determined that once-through designs were not a feasible alternative design and eliminated it from further consideration as part of the proposed Lee Nuclear Station Units 1 and 2 cooling system.

9.4.1.3 Cooling Pond

Use of a recirculating cooling pond separate from the Broad River was considered as an alternative cooling system design. Studies performed by Duke to determine the size pond needed for two AP1000s show that a recirculating pond would likely need to cover an area of 7000 ac (Duke 2009c). The topography around the Lee Nuclear Station site does not allow construction of a pond this size. Even if it did, the pond would eliminate substantially greater areas of wetlands, terrestrial habitat, and natural surface-water habitat than would other CWS alternatives. The review team determined that due to limitations of the surrounding topography, the impact of the loss of land and natural habitat associated with development of additional cooling ponds, a cooling system using a recirculating cooling pond was not an environmentally preferable alternative at the Lee Nuclear Station site.

9.4.1.4 Spray Canals

Spray-canal cooling systems use engineered canals to cool water and enhance evaporative cooling by spraying water into the atmosphere. In addition to evaporation, heat transfer from the spray canals to the atmosphere occurs through black-body radiation and conduction. A spray-canal system alternative was evaluated for cooling proposed Lee Nuclear Station Units 1 and 2, and was determined to require a canal approximately 2.5 mi long and 200 ft wide (Duke 2009c). The canal would require a water area of approximately 60 ac and a disturbance area of approximately 90 ac, assuming that an additional land area of 50 percent were required for temporary disturbance. Because of the linear geometry of the spray canal, Duke would likely have to acquire offsite land, cross and close off public roadways, and would have little flexibility to avoid wetlands and other sensitive habitat. Furthermore, terrestrial and aquatic habitat adjacent to the canal could be exposed to drift from spray operations. Based on the additional land and terrain requirements to build the spray canal and the possible impact from spray drift, the review team concludes that use of a spray canal would not be an environmentally preferable alternative for the Lee Nuclear Station site.

9.4.1.5 Dry Cooling Towers

Dry cooling towers have never been used to cool nuclear or fossil facilities of this size. Dry cooling towers would eliminate virtually all water-related impacts from the cooling system operation. No makeup water would be needed for cooling, and no blowdown water would be generated. This alternative could reduce water-use impacts, and likely avoid impacts associated with the building of Make-Up Pond C. Dry cooling systems would be larger than the proposed cooling-tower systems, and would require more onsite land to accommodate the large dry cooling structures. Dry cooling systems can result in a significant loss in dependable electrical generation capacity particularly during higher ambient temperature conditions because the theoretical approach temperature is limited to the dry-bulb temperature and not the lower wet-bulb temperature. The review team determined that historical local air temperatures would result in the loss of generation at critical times of high demand for electricity due to the loss of sufficient condenser vacuum. The dry cooling system design would not allow the plant to meet its stated goal as a baseload power source. Additional electrical losses occur with dry cooling due to the parasitic energy requirements of the large array of fans involved. This loss in generation efficiency translates into increased impacts on the fuel cycle. The review team therefore determined that building and operation of dry cooling towers would not be an environmentally preferable alternative for the Lee Nuclear Station site due to the impact on plant availability and capacity, as well as inefficiencies in energy production resulting in higher fuel-cycle impacts.

9.4.1.6 Combination Wet/Dry Hybrid Cooling-Tower System

Combination wet/dry hybrid cooling towers have never been used to cool nuclear or fossil facilities of the size proposed by Duke (i.e., 2234 MW(e)). A mechanical draft wet/dry hybrid cooling-tower system uses both wet and dry cooling cells to limit consumption of cooling water, often with the added benefit of reducing plume visibility. Water used to cool the turbine generators generally passes first through the dry portion of the cooling tower where heat is removed by drawing air at ambient temperature over tubes through which the water is moving. Cooling water leaving the dry portion of the tower then passes through the wet tower where the water is sprayed into a moving air stream and additional heat is removed through evaporation and sensible heat transfer. When ambient air temperatures are low, the dry portion of these cooling towers may be sufficient to meet cooling needs. The use of the dry portion of the system would result in a loss in generating efficiency that would translate into increased impacts on the fuel cycle. Duke provided an analysis of a hybrid cooling system design for proposed Lee Nuclear Station Units 1 and 2. For hybrid cooling towers, approximately 5500 ac-ft of additional supplemental water would be required compared to approximately 11,000 ac-ft of supplemental water to support wet cooling towers for Lee Nuclear Station Units 1 and 2 (Duke 2010k, Duke 2011e). The hybrid cooling system design would also increase the acreage of jurisdictional wetlands affected by about 62 percent but reduce the linear feet of jurisdictional streams affected by about 15 percent compared to the proposed wet cooling-tower system, due to the need to relocate several facilities of the proposed design to accommodate the large size of the dry cooling towers (Duke 2011h). Therefore, the hybrid cooling system would not eliminate the need for Make-Up Pond C or the impacts associated with its construction. The review team determined that while the hybrid cooling technology appears to be feasible for Lee Nuclear Station site, it still poses several significant technical challenges for its installation and operation. Therefore, the review team concludes that the building and operation of a combined wet/dry cooling-tower system would not be an environmentally preferable alternative for the Lee Nuclear Station site.

9.4.1.7 Mechanical Draft with Plume Abatement

Adding additional heat to a saturated cooling-tower exhaust, without adding additional water, would result in subsaturated water vapor. Subsaturated water vapor reduces the potential for a visible plume. The concept behind a mechanical draft cooling tower with plume abatement is similar to the wet/dry hybrid cooling system described above with the design parameters focused on reducing the visual plume. Such designs may also result in slightly less consumptive water use than mechanical draft cooling towers without plume abatement. The aesthetic impacts at the Lee Nuclear Station site with a mechanical draft cooling tower without plume abatement were determined to be SMALL; therefore, a mechanical draft tower with plume abatement offers no significant advantage. These towers often have a larger footprint and require additional energy to operate, resulting in a net loss of energy available to meet the demand for power. For these reasons, the review team concludes that the building and operation of mechanical draft cooling towers with plume abatement would not be an environmentally preferable alternative for the Lee Nuclear Station site.

9.4.2 Circulating-Water Systems

The review team also evaluated alternatives to the proposed intakes and discharges for the normal heat-sink cooling system, based on the proposed heat-dissipation system water requirements. The capacity requirements of the intake and discharge system are defined by the proposed heat-dissipation system. For proposed Lee Nuclear Station Units 1 and 2, the proposed heat-dissipation system is a closed-cycle system that uses mechanical draft cooling towers for heat dissipation.

As indicated in Table 3-10, the maximum makeup-water withdrawal for two AP1000 units at the site is 60,001 gpm (134 cfs). Duke considered two potential sources of makeup-water supply for the Lee Nuclear Station site: the Broad River and groundwater (Duke 2009c). In addition, Duke also considered water reuse in its NPDES permit application (Duke 2011a).

9.4.2.1 Intake Alternatives

The review team considered intake alternatives for taking water from the Broad River for ultimate use by the condenser cooling system. The proposed intake structure for Lee Nuclear Station Units 1 and 2 is described in detail in Section 3.2.2.2. Duke considered three alternatives for the intake system in addition to the proposed system: (1) intake structure on an intake canal, (2) perforated pipe intake structure, and (3) infiltration bed intake structure.

Intake Structure on an Intake Canal

Duke considered an intake structure on a canal. The intake structure would be located at the end of a 700-ft-long intake canal coming off the Broad River. A submerged weir would be located at the canal entrance to route streambed load past the canal entrance. The dimensions of the canal would be selected to maintain water velocity in the canal at less than 0.5 fps in compliance with the requirements of the Clean Water Act, Section 316(b). The low water velocity in the intake canal would allow some silt to settle before it reaches the intake structure, so the silt would need to be periodically removed from the canal during operation to maintain the initial dimensions. Use of an intake canal would provide better protection from floodwaters and result in a shorter piping system to Make-Up Pond A. The shorter piping system would result in lower pumping costs.

Building an intake structure at the end of an intake canal would require 4 ac of land and would disturb approximately 0.5 ac of river bottom. Use of an intake canal would also allow the intake structure and most of the canal to be built before the canal is connected to the river, resulting in no effect on the river during installation except while installing the weir at the entrance. When creating the opening at the mouth of the canal, the turbidity in the river would be increased for a short time. The impact on the river would be temporary and minor. Duke did mention, however, possible problems with river channel stability (Duke 2009c).

Perforated Pipe Intake Structure

A perforated pipe intake would draw water into the system through seven 36-in.-diameter pipes with 3/8-in. slotted openings located on the river bottom. Four 3-ft-diameter pipes would carry the water to pumps located in a concrete structure on land approximately 150 ft from shore. This design would result in through-opening intake velocities of less than 0.5 fps. The intake system would include piping to backwash the perforated pipe. The perforated pipe would be embedded in a concrete mat on the river bottom that would be anchored to bedrock. The concrete would protect the intake pipes from the effect of erosion and damage from large debris in the river. The river currents would carry both fish and debris past the openings in the perforated pipe. The frequency with which the perforated pipes would be backwashed would be determined by head loss as the slots became blocked by debris. Building the facility would require approximately 1 ac of land, and would disturb less than 0.5 ac of river bottom (Duke 2009c). A cofferdam would need to be constructed so that the anchor system, concrete mat, perforated pipe, and piping to the pump structure could be built in a dry setting.

Infiltration Bed Intake Structure

An infiltration bed intake structure would consist of a 100-ft-wide and 350-ft-long gravel infiltration bed with 6-in.-diameter perforated pipes on 42-in. centers embedded in the gravel to collect the water. Four 3-ft-diameter pipes would carry the water from the perforated pipes to pumps located in a concrete structure on land. The intake system would include piping to backwash the gravel infiltration bed.

A cofferdam would need to be constructed so that the gravel filter, perforated pipe, and piping to the pump structure could be built in a dry setting. An area of slightly less than 1 ac of the river bottom would be excavated to approximately 6 ft deep to allow construction of the infiltration bed. A cofferdam large enough to surround the construction area would result in increased water velocities in the river and likely cause scour of the river bottom adjacent to the cofferdam. These impacts would be expected to be temporary.

Intake velocities would be negligible, reducing the possibility of fish impingement. Backwashing the gravel bed would push entrapped sediment and debris back into the river current, allowing it to continue downstream. The frequency with which the gravel bed would need to be backwashed would be determined by head loss as the bed became loaded with debris. Frequent backwashing is anticipated, which would cause an increase in turbidity downstream of the gravel bed. In addition, river currents could scour the gravel bed leading to impaired performance.

Intake Alternatives Summary

The intake structure on an intake canal would require additional land disturbance relative to the proposed intake design and may have greater risk during operation due to river channel instability. The perforated pipe intake structure would require similar land disturbance to that of the proposed intake design and may have greater risk during operation due to damage of the pipe. Building an infiltration bed intake structure would disturb nearly 1 ac of river bed. In addition, a number of installation and operational considerations related to the infiltration bed limit the practicality of this alternative. The impacts associated with aquatic ecology for the proposed intake have been determined to be minor in Chapters 4 and 5. Therefore, the review team determines that there are no alternative intake designs that would be environmentally preferable to the proposed intake design for the Lee Nuclear Station site.

9.4.2.2 Discharge Alternatives

Duke proposes to discharge blowdown from Lee Nuclear Station Units 1 and 2 to the Broad River immediately behind Ninety-Nine Islands Dam. A detailed description of the proposed discharge system is presented in Section 3.2.2.2. Duke considered a single port spillway apron discharge, a bank-side single port discharge structure, and river bottom diffuser as alternatives to the proposed discharge diffuser.

Single Port Spillway Apron Discharge

The single port spillway apron discharge was rejected by Duke because Ninety-Nine Islands Dam is considered a historical site and the addition of the discharge structure to the apron spillway would unacceptably alter the appearance of the historical site. In addition, modeling of the thermal impacts of such a discharge indicates that this alternative would not meet State thermal requirements in the river below the spillway (Duke 2009c).

Single Port Pipe Discharge

A single port discharge structure located on the bank of the Broad River downstream of Ninety-Nine Islands Dam would consist of a single pipe anchored through a concrete headwall discharging into the river near the elevation of the surface of the river. Modeling of the thermal impacts of such a discharge indicates that State thermal requirements in the river would not be met with this discharge structure design (Duke 2009c).

River Bottom Single Port Diffuser

The installation of a river bottom single port diffuser would result in disturbance to the streambed (Duke 2009c). The operation of a river bottom single port diffuser would be affected by streambed disturbances, particularly during high flows.

Discharge Alternatives Summary

The single port apron spillway discharge alternative would alter the appearance of a historical site. Both the single port apron spillway and the single port pipe discharge alternatives would have limited mixing associated with the discharge design. The river bottom single port diffuser would result in disturbance to the river bottom during installation and would be subject to streambed disturbances during high flows. The review team determined that the impacts of operation of the proposed discharge system would be minor and that no alternative discharge designs would be environmentally preferable to the proposed discharge design at the Lee Nuclear Station site.

9.4.2.3 Water Supplies

The review team considered alternative sources for the CWS, including water reuse, groundwater, and surface water.

Water Reuse

Sources of water for reuse can come either from the plant itself or from other local water users. Sanitary wastewater-treatment plants are the most ubiquitous sources of water for reuse. Agricultural processing, industrial processing, and oilfield production can also provide significant supplies of water for reuse. Additional treatment (e.g., tertiary treatment, chlorination) may be required to provide water of appropriate quality for the specific plant need. The population density is low, and there is little industry around the Lee Nuclear Station site, so adequate reliable wastewater sources are not currently available. In Duke's NPDES application (Appendix J to Part VII of NPDES permit application [Duke 2011a]), a study of the feasibility of piping wastewater effluent from both the Gaffney Board of Public Works Wastewater Treatment plants to the proposed Make-Up Pond C was summarized. The pipeline would be required to extend over 10 mi. While this pipeline would reduce the withdrawals from the Broad River from the refill system, the review team determined, due to the small combined capacity of the wastewater-treatment plants that water reuse would not eliminate the need for either the refill intakes on the Broad River or Make-Up Pond C. Therefore, the review team determined that water reuse would not be an environmentally preferable alternative to Duke's proposed water supply and it was not evaluated further.

Groundwater

Groundwater is not considered a viable source of cooling water for Lee Nuclear Station Units 1 and 2 because the geologic formations in the vicinity of the site generally are not permeable enough to sustain the well yields required to support the condenser cooling-water makeup need (60,000 gpm) (Duke 2009c). Characterizations performed at the Lee Nuclear Station site support this assertion (see Chapter 2). The review team finds that the groundwater resource could not meet the cooling-water demands of proposed Lee Nuclear Station Units 1 and 2. Therefore, the review team determined that groundwater would not be a feasible alternative to Duke's proposed water supply.

Expansion of Make-Up Pond B

Duke (2009b, 2010k) evaluated expansion of Make-Up Pond B to provide an alternative supplemental water storage volume needed for Lee Nuclear Station Units 1 and 2. The 2010 evaluation was performed in the context of use in combination with a hybrid wet-dry cooling option. A significant volume of spoil material would need to be excavated and transported to a disposal site. The closest practical disposal site would be within the London Creek watershed and the proposed Make-Up Pond C area. Operation of the expanded Make-Up Pond B would not be able to comply with thermocline protection requirements of EPA's Section 316(b) of the Clean Water Act because there would not be sufficient volume to both meet the plant's needs and meet the thermocline protection requirements. Therefore, the review team determined, based on the impacts associated with excavation and disposal of spoil material during pond expansion, and the inability of the expanded Make-Up Pond B to comply with thermocline protection requirements, that expansion of Make-Up Pond B is not an environmentally preferable alternative.

9.4.2.4 Water Treatment

Both inflow and effluent water may require treatment to ensure that they meet plant water needs and effluent water standards. As described in Section 3.4.4, Duke proposes to add chemicals to plant water to meet appropriate water-quality process needs. The chemistry of effluent water is regulated by the EPA through the NPDES permitting process. The largest chemical inputs are required to maintain the appropriate chemistry in the cooling towers to preclude biofouling. The effluents from cooling-tower blowdown are specifically regulated in 40 CFR Part 423 by the EPA to protect the environment. The review team identified no environmentally preferable alternative to Duke's proposed chemical water treatment.

9.4.3 Summary of System Design Alternatives

The review team considered various alternative system designs, including seven alternative heat-dissipation systems and multiple alternative intake, discharge, and water-supply systems. The review team identified no alternatives environmentally preferable to the proposed Lee Nuclear Station plant systems design.

9.5 U.S. Army Corps of Engineers Alternatives Evaluation

The 404 Guidelines stipulate that no discharge of dredged or fill material into waters of the United States (including jurisdictional wetlands) shall be permitted if there is a practicable alternative that would have a less adverse impact on the aquatic environment, as long as the alternative does not have other significant adverse environmental consequences. An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by the applicant that could reasonably be obtained, used, expanded, or managed in order to fulfill the basic purpose of the proposed activity may be considered. Thus, this analysis is necessary to determine which alternative is the LEDPA that meets the project purpose and need. Even if an applicant's proposed alternative is determined to be the LEDPA, the USACE must still determine whether the LEDPA is contrary to the public interest. The USACE Public Interest Review, described in 33 CFR 320.4 (and further discussed in Appendix I), directs the USACE to consider the reasonably foreseeable benefits and detriments of the proposed project in light of a number of factors relevant to the public interest. A permit would not be issued for an alternative that is not the LEDPA, nor would a permit be issued for an activity that is determined to be contrary to the public interest.

9.5.1 Onsite Alternatives

As part of its process for evaluating permits, the USACE reviewed Duke's application and ER (Duke 2009b, c) for the proposed Lee Nuclear Station Units 1 and 2 project, responses to RAIs, data presented in this EIS regarding impacts on alternative sites, and Duke's information addressing onsite alternatives (i.e., alternative cooling-tower designs) for the Lee Nuclear Station site to minimize impacts on wetlands and other waters of the United States. Within this documentation, Duke provided a detailed description of the steps taken to minimize onsite impacts. According to information provided by Duke, the site layout with the least impact on waters of the United States for the proposed project is the Lee Nuclear Station site with 5.43 ac of wetland impacts, 29.63 ac of open-water impacts, and 67,285 linear ft of impacts on streams.

This EIS provides environmental information and analyses upon which the LEDPA determination will be based. It also considers public feedback received in the form of public comments on the draft EIS. Using this information as well as information in the applicant's Federal permit application, the USACE will address whether the LEDPA criterion is met in the Record of Decision.

9.5.2 Duke Alternative Sites

As noted previously, the evaluation and comparison of potential impacts on waters of the United States among the proposed and three alternative sites are limited by the use of reconnaissance-level data and the lack of detailed data for all but the Lee Nuclear Station site. The USACE issued Duke a jurisdictional determination on January 11, 2013, that identified 31.18 ac of wetlands,284.4 ac of open waters, and 167,071 linear ft of streams (based on field delineations) that are subject to Clean Water Act jurisdiction within the proposed project boundary, as well as 10.61 ac of non-jurisdictional open-water ponds (USACE 2013a). As described in Section 9.5.1 Onsite Alternatives, proposed impacts would affect a portion of these areas, including 5.43 ac of wetland impacts, 29.63 ac of open-water impacts, and 67,285 linear ft of impacts on streams. Waters of the United States were estimated for the Perkins, Keowee, and Middleton Shoals alternative sites using a combination of available data resources, including FWS National Wetlands Inventory mapping, U.S. Department of Agriculture–Natural Resources Conservation Service soils mapping, 2006 infrared aerial imagery, SCDHEC State Navigable Waters mapping, USGS 7.5-minute quadrangle maps, and the National Hydrography Dataset. For the alternative sites and their associated transmission-line corridors, acres of wetlands are given separately for forested and non-forested wetlands, as well as linear distance for streams. It is important to note that transmission-line routes associated with the three alternative sites are provisional and therefore would be subject to change. Note also that impacts on alternative sites include those areas that would be occupied by principal facilities such as the power block, cooling towers, and switchyard, as well as impacts resulting from intake and discharge water pipelines. In the absence of detailed topographic design data, it is not feasible to include impacts from associated fill slopes for these components or from other ancillary facilities on the alternative sites.

Table 9-19 presents the impacts on waters of the United States at the alternative sites based on reconnaissance-level information, and at the Lee Nuclear Station site based on field-delineated information. Table 9-19 includes impacts within each of the sites where nuclear facilities would be located, within associated cooling pond footprints, transmission-line corridors, railroad corridor, cooling-water pipelines, and roads.

9.5.3 Evaluation of the 404(b)(1) Guidelines

As part of its permit decision for the Lee Nuclear Station, the USACE must evaluate the compliance of the proposed project with the 404 Guidelines (40 CFR Part 230). This analysis will evaluate whether the discharge of dredged or fill material will cause or contribute to significant degradation of the waters of the United States. Findings with respect to the potential for significant degradation are based upon factual determinations, evaluations, and tests required by Subparts B and G of the 404 Guidelines, after consideration of information required by Subparts C through F of the 404 Guidelines. This evaluation addresses the impacts associated with placement of dredged or fill material into waters of the United States, including special aquatic sites. Note that this evaluation does not evaluate the discharge of water from the outfall pipe itself during normal operations of the Lee Nuclear Station pursuant to Section 402 of the Clean Water Act (CWA) or effects from the operation of intake structures in accordance with Section316(b) of the CWA.

Table 9-19. Comparison of Impacts on Waters of the United States for the Proposed and Three Alternative Sites

	Perkins Site[a]	Keowee Site[a]	Middleton Shoals Site[a]	Lee Nuclear Station[b] (Proposed)
Nuclear Station Sites and Supplemental Cooling–Water Reservoirs				
Wetland impacts (ac)	92.5	22.5	175.2	3.55
Stream impacts (linear ft)	207,000	144,000	378,000	65,795
Open water impacts (ac)	2.4	12.3	37	29.63
Total wetland and open-water impacts (ac)	94.9	34.8	212.2	33.18
Transmission Corridors, Railroad Corridor, Cooling-Water Pipelines, Roads				
Wetland impacts (clearing forest, ac)[a]	24	3	4.2	1.88[c]
Stream impacts (linear ft)[a]	15,000	5000	24,000	1490
Open water impacts (ac)	0.2	2.8	19	0
Total wetland and open-water impacts (ac)	24.2	5.8	23.2	1.88
Grand Total − wetland and open-water impacts (ac)	119.1	40.6	235.4	35.06
Grand Total – stream impacts (linear ft)	222,000	149,000	402,000	67,285

Source: Duke 2010g, 2012n

(a) Impacts on wetlands and other waters of the United States for the Perkins, Keowee, and Middleton Shoals alternative sites are based on published mapping data, including but not limited to National Wetlands Inventory mapping and other available information sources described in the text.

(b) Impacts on wetlands and other U.S. waters of the United States for the Lee Nuclear Station Site alternative (proposed action) are based on field delineations.

(c) Includes 0.21 acres of forest clearing in wetlands located on the Lee Nuclear Station site, as noted in Table 2-20.

The proposed construction of Lee Nuclear Station and required ancillary features, such as Make-Up Pond C (also known as Drought Contingency Pond C), transmission lines, and the railway corridor will affect 67,285 ft (12.74 mi) of stream, 5.43 ac of wetlands, and 29.63 ac of open waters. Table 9-20 summarizes the impacts on waters of the United States according to major project element and impact activity. Compensatory mitigation will be provided for all unavoidable wetland, stream, and open-water impacts as wetland and stream mitigation per the 2008 Mitigation Rule as implemented by the USACE Charleston District Guidelines for Preparing a Compensatory Mitigation Plan (USACE 2010). The following sections discuss the aquatic resources that will be affected by the proposed project to provide a context of impacts pursuant to the 404 Guidelines.

Table 9-20. Summary of Impacts on Waters of the United States

		Open-Water Impacts (ac)					
		Perm Fill	**Temp Fill**	**Perm Dredging**	**Perm Flooding**	**Temp Drain**	**TOTAL**
Broad River (Ninety-Nine Islands Reservoir)	Intake Structure	0.06		0.48			0.54
	Diffuser		0.04	1.00		0.15	1.19
Make-Up Pond A	Intake Structure	0.22	0.20	1.06		1.08	2.56
	Refill Structure	0.07				0.48	0.55
	Cofferdam Dredging			2.70			2.70
	Outcrop Dredging			0.56			0.56
Make-Up Pond B	Intake/Refill Structure	1.07	0.43			0.09	1.59
	Refill Structure	0.06	0.08			0.13	0.27
	Cofferdam Dredging			2.09			2.09
Make-Up Pond C	Lake Cherokee Dam and Spillway	0.02					0.02
	Impoundment				0.03		0.03
	Farm Pond Draining					17.53	17.53
Subtotals		1.50	0.75	7.89	0.03	19.46	
TOTAL							**29.63**

		Stream Impacts (linear ft)						**TOTAL**
		Perm Fill	**Temp Fill**	**Perm Excavation**	**Perm Flooding**	**Temp Flood**	**Temp Clearing**	
Make-Up Pond C	Intake/Refill Structure	98						98
	Dam and Toe Drain	1855		267				2122
	Dam Excavation Spoil	730						730
	Saddle Dikes	74						74
	Spillway/Stilling Basin Armoring	636						636
	SC 329 Relocation	396						396
	Construction Roads	223						223
	Lake Cherokee Dam and Spillway	218						218
	Impoundment				60,414			60,414
	50-ft Buffer Clearing						884	884
Railroad Corridor	Culvert Replacement	145	25			1320		1490
Subtotals		4375	25	267	60,414	1320	884	
TOTAL								**67,285**

Table 9-20.(contd)

		Wetland Impacts (ac)					TOTAL
		Perm Fill	Temp Fill	Perm Flooding	Temp Flood	Perm Clearing	
Make-Up Pond C	Dam	0.04					0.04
	Dam Excavation Spoil	0.24					0.24
	SC 329 Relocation	0.01					0.01
	Construction Roads		0.04				0.04
	Impoundment			3.22			3.22
Railroad Corridor	Culvert Replacement	0.11	0.06		0.35		0.52
Transmission Lines (includes 0.21 ac of forest clearing in wetlands located on the Lee Nuclear Station site)	Forested Clearing					1.36	1.36
Subtotals		0.40	0.10	3.22	0.35	1.36	
TOTAL							**5.43**

Perm = Permanent; Temp = Temporary

9.5.3.1 Potential Effects on Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C)

40 CFR 230.20 Substrate

The substrate of the aquatic ecosystem underlies open waters of the United States and constitutes the surface of wetlands. It consists of organic and inorganic solid materials and includes water and other liquids or gases that fill the interstices between solid particles. The discharge of fill material resulting from this project will eliminate or alter the substrate material and/or depth of the waters of the United States at the disposal sites.

Direct Impacts

Intake/Refill Structures: The placement of fill material and a concrete structure for the construction of the Broad River intake will result in permanent loss of 0.06 ac of substrate in the Ninety-Nine Islands Reservoir (Table 9-20). A temporary cofferdam will be used during the river intake construction; however, upon intake construction completion, all temporary cofferdam fill locations will be removed and the substrate ultimately dredged, constituting the permanent impact. Dredging associated with the construction of the river intake structure will lower the elevation of 0.48 ac (Table 9-20) of substrate in Ninety-Nine Islands Reservoir adjacent to the structure an average of 8.5 ft below the existing grade.

The placement of fill and a concrete structure for the construction of the Make-Up Pond A (also known as Sedimentation Pond A) intake structure will result in the permanent loss of 0.22 ac of substrate in Make-Up Pond A, while the placement of the cofferdam will result in the temporary loss of 0.20 ac of substrate. The cofferdam will be removed upon completion of intake construction. Dredging associated with the construction of the Make-Up Pond A intake will result in lowering of the bottom elevation of 1.06 ac of substrate in Make-Up Pond A an average of 21 ft below the existing grade. The placement of fill and a concrete structure for the construction of the Make-Up Pond A refill structure will result in the loss of 0.07 ac of substrate in Make-Up Pond A (Table 9-20).

The construction of the Make-Up Pond B (also known as Drought Contingency Pond B) intake/refill structure will result in the permanent loss of 1.07 ac of substrate and 0.43 ac of temporary fill in Make-Up Pond B. The Make-Up Pond B intake/refill structure will result in permanent impact of 0.06 ac of substrate and 0.08 ac of temporary fill in Make-Up Pond B. In addition to the impacts mentioned above, the cofferdam used to construct the Make-Up Pond B intake/refill structure will require the dredging of 2.09 ac in Make-Up Pond B (Table 9-20) to an approximated average of 20 ft below existing grade over the 2.09-ac area to be dredged.

The construction of the Make-Up Pond C intake/refill structure (also known as the Make-Up Pond C intake/discharge structure) will result in the placement of a concrete structure in 98 ft of London Creek (Table 9-20). Sections of London Creek upstream and downstream of this location will ultimately be impounded, constituting a secondary impact.

<u>Diffuser Structure</u>: The diffuser will be attached to the face of the Ninety-Nine Islands Dam; therefore, there will be no permanent placement of fill from this activity. The construction of the diffuser structure will involve the placement of a temporary cofferdam near the bank of the Ninety-Nine Islands Reservoir. This activity will result in the temporary placement of fill within 0.04 ac of substrate within the Ninety-Nine Islands Reservoir. Dredging associated with the installation of the diffuser and at the forebay of the dam will result in 1.00 ac of impact on the substrate of Ninety-Nine Islands Reservoir (Table 9-20).

<u>Make-Up Pond A Bottom Dredging</u>: In addition to the dredging associated with the structures described above, the existing cofferdams and soil outcrops in Make-Up Pond A will be removed by dredging. These artificial features were created during the construction activities of the Cherokee Nuclear Station. A total of 3.26 ac of Make-Up Pond A substrate will be dredged (Table 9-20).

<u>Make-Up Pond C Dam Infrastructure</u>: Fill material for the construction of the dam and toe drain for Make-Up Pond C will affect 0.04 ac of wetland and 1855 linear ft of stream (Table 9-20). Fill material associated with the construction of the saddle dikes will fill 74 linear ft of stream. These fill activities will eliminate the substrate of these waters of the United States. The construction of the spillway, stilling basin, and placement of riprap will result in armoring, via fill placement,

within 636 linear ft of stream habitat (Table 9-20). The placement of this material will permanently change the substrate of the aquatic resource from natural sand, gravel, and cobble to riprap and concrete.

<u>50-Ft-Wide Make-Up Pond C Buffer</u>: The mechanical clearing of 884 linear ft of stream (Table 9-20) and less than 0.01 ac of wetland may result in impacts on the substrate of these aquatic resources due to potential disturbance from tires and treads from the equipment and grubbing operations.

<u>Borrow Excavation</u>: The excavation of material for the construction of the Make-Up Pond C dam and toe drain will result in the elimination of substrate for 267 linear ft of stream (Table 9-20). This area will ultimately be inundated by the impoundment of Make-Up Pond C and a new reservoir substrate will form.

<u>SC 329 and Construction Roads</u>: The relocation of SC 329 will result in the construction of culverts, affecting 396 linear ft of stream (Table 9-20). Culverts represent fill and will completely replace, with a hard substrate, the natural stream bottom habitat of these stream sections. While culvert bottoms will accumulate sediments over time, with exception of aquatic organism passage, aquatic functions are considered lost. The placement of fill associated with SC 329 relocation will permanently affect 0.01 ac of wetland substrates. Roads required for the construction of Make-Up Pond C will result in the permanent placement of culverts and fill material within 223 linear ft of stream substrate, and temporary placement of fill within 0.04 ac of wetlands (Table 9-20). These roads will ultimately be inundated by the construction of Make-Up Pond C, and a new aquatic substrate will form.

<u>Lake Cherokee Dam and Spillway</u>: The placement of riprap to stabilize the embankment of the Lake Cherokee Dam will permanently affect 218 linear ft of stream substrate and 0.02 ac of open water (Table 9-20). The riprapped embankment will ultimately be inundated by Make-Up Pond C.

<u>Spoil Areas</u>: Spoil excavated during the construction of the dam for Make-Up Pond C will be stockpiled onsite. The construction design maximizes the use of upland areas for spoil disposal; however, the quantity of the material requires unavoidable impact on some waters of the United States for adequate spoil storage. A majority of the spoil material will be placed in the location of the farm ponds, including within low-quality fringe wetlands around the pond margins. The placement of this material will result in permanent impact on730 linear ft of stream substrate and 0.24 ac of wetland substrates (Table 9-20).

<u>Railroad Culvert Replacement</u>: Two existing, undersized 120-in.-diameter culverts with associated scour downstream of the railroad crossing with London Creek must be replaced. This work will result in the placement of fill material within 145 linear ft of London Creek, 140 linear ft of which will be new culvert, and placement of permanent fill within 0.11 ac of

wetlands. Construction cofferdams, which constitute fill, will temporarily affect 25 linear ft of London Creek and 0.06 ac of wetland (Table 9-20). Temporary impacts on the substrate will be restored to preconstruction conditions after removal of the cofferdam.

Secondary Effects

Draining from Temporary Cofferdams: Use of temporary cofferdams during construction of the intake/refill structures in Make-Up Ponds A and B and the diffuser will temporarily remove water behind the cofferdams during construction. This will cause 1.93 ac of open water to be temporarily drained (Table 9-20). Additional area behind the cofferdams will be drained during construction; however, these areas will ultimately experience other substrate impacts (e.g., dredging or placement of riprap for stabilization), which were previously discussed inapplicable direct impacts sections. Temporary draining behind the cofferdams will have minimal adverse effects on the aquatic substrate within these localized areas. The substrate would not serve as aquatic habitat during construction; however, upon completion of construction and removal of the cofferdams, the drained aquatic substrate would be re-inundated and should revert to providing aquatic functions.

Impoundment of Make-Up Pond C: The impoundment of Make-Up Pond C would convert 60,414 linear ft of streams, 3.22 ac of wetlands, and 0.03 ac of open-water habitat to deep open water (Table 9-20). The substrate would no longer provide the function of the original habitat, but would provide a different function as substrate for a reservoir. In most instances, substrate within the new impoundment would be a deepwater habitat with potentially lower dissolved oxygen content in the vicinity of the substrate. This, along with the lentic conditions of the impoundment, will lead to a different community of benthic macroinvertebrates inhabiting the substrate. The presence of the dam may also affect the substrate of London Creek downstream of the dam, principally by increased fluvial erosion due to diminished sediment loading.

Draining of Farm Ponds: Draining the farm ponds on the Make-Up Pond C site will result in impacts on 17.53 ac of open-water habitat (Table 9-20). Spoil material associated with the excavation for the Make-Up Pond C dam will be placed in some of the drained open-water habitat, while other drained open-water habitat will ultimately be inundated by Make-Up Pond C. Spoil placement will result in the elimination of the aquatic substrate, while aquatic substrate will redevelop within drained farm ponds that will be inundated by Make-Up Pond C.

Transmission Lines: A total of 1.36 ac of forested wetland will be hand-cleared on the Lee Nuclear Station site and for the transmission lines (Table 9-20). No impact on the substrate of these wetlands is expected.

Railroad Culvert Replacement: If a 10-year storm event occurs during construction, 1320 linear ft of stream and 0.35 ac of wetland may be temporarily flooded during the railroad culvert replacement due to water impounding from the cofferdams (Table 9-20). Temporary flooding of these resources would have a minimal adverse effect on the substrate.

40 CFR 230.21 Suspended Particulates/Turbidity

Suspended particulates in the aquatic ecosystem consist of fine-grained mineral particles, usually smaller than silt, and organic particles. Suspended particulates may enter waterbodies as a result of sheet flow runoff, flooding, vegetative and planktonic breakdown, resuspension of bottom sediments, and human activities including dredging and filling activities. Particulates may remain suspended in the water column for variable periods because of agitation of the water mass and particle, physical, and chemical properties of particle surfaces. Aquatic areas of protracted high turbidity and suspended particulates may incur reduced light penetration and a lower rate of photosynthesis and primary productivity. Sight-dependent species may suffer reduced feeding ability, leading to limited growth and lowered resistance to disease if high levels of suspended particulates persist. The biological and chemical content of the suspended material may react with dissolved oxygen in the water and result in oxygen depletion; however, only a localized effect would be likely, given the small areas of impact and short duration of construction. Toxic metals and organic elements, pathogens, and viruses absorbed by or adsorbed to fine-grained particulates may become biologically available to organisms either in the water column or on the substrate. Significant increases in suspended particulate levels create turbid plumes that are highly visible and aesthetically displeasing. The spatial extent and persistence of these adverse impacts are influenced by numerous inter-related conditions, including the increase in suspended particulates above naturally occurring levels; duration of the higher levels; current patterns, water levels and fluctuations when discharges occur; volume, rate, and duration of the discharge; particulate deposition rate; and the seasonal timing of the discharge.

Direct Impacts

Intake/Refill Structures: Fill used to construct the intake and refill structures will be placed behind temporary cofferdams, thereby limiting the dispersal of particulates into the water column. Dredging associated with the intake/refill structures may lead to minor temporary increases in turbidity and suspended particulates.

Diffuser Structure: Excavation into the bank of the Ninety-Nine Islands Reservoir during diffuser structure installation will occur behind a temporary cofferdam, limiting the potential for turbidity during this activity. Dredging of the Ninety-Nine Islands Dam forebay to improve diffuser operation may lead to temporary, minor increases in turbidity.

Make-Up Pond A and Make-Up Pond B: Minor increases in turbidity will occur during the dredging of existing cofferdams and soil outcrops present within Make-Up Pond A and Make-Up Pond B. According to the applicant, and by permit conditions to be included in any Department of the Army permit that may be issued, BMPs, including the use of turbidity curtains, would be used to contain the effects of increased turbidity during dredging.

Make-Up Pond C Dam Infrastructure: The placement of fill material for the dam for Make-Up Pond C will occur when flow from London Creek is diverted using pumps. Cofferdams would be placed upstream and downstream of the proposed dam construction. Placing fill during dry conditions would limit the potential for suspended particulates and turbidity to enter the London Creek system downstream of the dam. Fill material placed in wetland areas will not result in suspended particulates in the water column.

50-Ft-Wide Make-Up Pond C Buffer: Mechanical clearing and grubbing of the 50-ft-wide buffer around Make-Up Pond C may result in minor amounts of turbidity within tributaries to London Creek.

Borrow Excavation: The excavation of material for the construction of the Make-Up Pond C dam and saddle dikes may result in localized turbidity within tributaries to London Creek.

SC 329 and Construction Roads: Construction of the culverts associated with the relocation of SC 329 and the construction roads will occur during dry conditions, and thus will limit the potential for turbidity in the aquatic ecosystem.

Lake Cherokee Dam and Spillway: The placement of riprap and associated grading to stabilize the embankment of the Lake Cherokee dam may temporarily increase turbidity within London Creek. The work on the emergency spillway for Lake Cherokee could result in localized and temporary turbidity conditions at the site of the work.

Spoil Areas: Spoil material placed in streams has the potential to contribute to temporary increases in turbidity in the subject streams.

Railroad Culvert Replacement: The replacement of the culvert at the railroad crossing of London Creek would occur when flow from London Creek is diverted around the work using pumps. Cofferdams would be placed upstream and downstream of the proposed work. Placing the fill during dry conditions would limit the potential for suspended particulates and turbidity to enter the London Creek ecosystem downstream of the culvert. The improved capacity of the new culvert will reduce downstream scour and limit turbidity during high-flow events.

Secondary Effects

Draining from Temporary Cofferdams: Draining behind the temporary cofferdams used to construct the intake, refill, and diffuser structures may contribute to temporary and localized increases in turbidity while water is pumped from behind the cofferdams. Pumps running to remove accumulated water behind the cofferdams from rainfall and leakage during construction may contribute to additional temporary and localized increases in turbidity.

Impoundment of Make-Up Pond C: The impoundment of London Creek would reduce the magnitude and duration of flood flows and interrupt downstream sediment and nutrient delivery. Long-term reduction in sediment load would affect channel formation and nutrient-cycling dynamics. This could result in fluvial erosion downstream of the dam because the sediment load may not be sufficient to replace sediment loss during higher flows. Sediment transport in the London Creek system has already been altered due to the presence of Lake Cherokee and several farm ponds on tributaries. Likewise, the presence of the Ninety-Nine Islands Dam on the Broad River approximately 1 mi downstream of the confluence of London Creek currently restricts sediment transport further downstream in the river. Because Make-Up Pond C will be constructed between these existing reservoirs, the effect on sediment transport in the Broad River system would be minor.

Draining of Farm Ponds: Draining the farm ponds may temporarily increase turbidity in tributaries to London Creek. Upon completion of pumping operations and dam removal, additional turbidity effects are not expected.

Transmission Lines: Because forested wetlands and riparian buffers will be hand-cleared within the transmission-line rights-of-way and disturbance to the soil is not expected, no increases in turbidity would occur.

Railroad Culvert Replacement: According to the applicant, if a 10-year storm event occurs during construction, temporary flooding may occur to portions of London Creek and adjacent wetlands due to the temporary cofferdam, which could lead to deposition of suspended particulates as the floodwaters recede. If these effects occur, they would be minor and localized.

40 CFR 230.22 Water

Water is the part of the aquatic ecosystem in which organic and inorganic constituents are dissolved and suspended. It constitutes part of the liquid phase of the substrate and is contained in its interstices. Water forms part of a dynamic aquatic life-supporting system. Water clarity; nutrient, chemical, physical, and biological content; dissolved gas levels; pH; and temperature contribute to its life-sustaining capabilities. The addition of contaminants during construction may temporarily reduce or eliminate the suitability of waterbodies for populations of aquatic organisms, and for human consumption, recreation, and aesthetics. The discharge of nutrients or organic material to the water column may lead to a high biochemical oxygen demand (BOD), which in turn may lead to reduced dissolved oxygen, thereby potentially affecting the survival of many aquatic organisms. Increases in nutrients may favor one group of organisms (e.g., algae) to the detriment of other, more desirable groups (e.g., submerged aquatic vegetation), potentially causing adverse health effects, objectionable tastes and odors, and other problems.

Direct Impacts

The placement of fill associated with intake structures, refill structures, the diffuser, Make-Up Pond C dam and associated infrastructure, SC 329, construction roads, the railroad culvert, and spoil areas may lead to temporary and minor changes in the clarity, color, odor, and taste of water within the vicinity of the work. Nutrients adhering to fill particles could lead to minor and localized increases in nutrient levels and BOD; however, BMPs, including erosion and sediment control, would minimize this potential. Likewise, the mechanical clearing of the 50-ft-wide Make-Up Pond C buffer; borrow excavation; and dredging at the intake, refill, diffuser structures, and existing cofferdams in Make-Up Pond A and Make-Up Pond B may lead to similar changes. However, these construction activities will be brief, and the area of impacts will be relatively small. Thus, the described work is not expected to result in more than minimal effects on water.

Secondary Effects

Draining from Temporary Cofferdams: The temporary cofferdams at the intake, refill, and diffuser structures will temporarily eliminate the water environment behind the cofferdams during construction of the structures. The water environment in these localized areas will return to preconstruction conditions upon removal of the cofferdams.

Impoundment of Make-Up Pond C: Changes in water temperature would be expected to result from the conversion of the London Creek ecosystem from a lotic system with associated vegetated wetlands to a large open-water reservoir. Temperature influences the chemical properties of natural waterbodies (e.g., amount of dissolved oxygen), which in turn can limit the ability of certain plants and animals to use these waterbodies. Impoundments may act as nutrient sinks, which could lead to increased BOD within deep areas of Make-Up Pond C. Clearing and grubbing of vegetation within the impoundment footprint prior to inundation will minimize the potential for significant increases in BOD after initial inundation. Impoundments do not seem to significantly affect the pH of a receiving stream (TDEC 2006). Approximately 0.6 mi of London Creek will remain between the proposed Make-Up Pond C dam and the confluence with the impounded waters of the Ninety-Nine Islands Reservoir. This segment of London Creek will likely experience less nutrient input after dam construction. The presence of Lake Cherokee on the headwaters of London Creek and several farm ponds on tributaries may already contribute to reduced nutrient levels in London Creek. Therefore, creation of Make-Up Pond C between Lake Cherokee and Ninety-Nine Islands Reservoir is not likely to contribute more than minor impacts on nutrient levels within the remaining 0.6-mi segment of London Creek or to the Broad River system. Lateral seepage from Make-Up Pond C due to the rise in the water table could increase water levels in some nearby private wells. As discussed in

Section 5.2.3, some temporary increases in turbidity may occur within private wells during the initial filling of Make-Up Pond C, but impacts on groundwater quality would be minor.

Draining of Farm Ponds: The draining of the farm ponds will eliminate the open water at these locations. Some of the farm pond areas will ultimately be re-inundated by the impoundment of Make-Up Pond C, while others will ultimately be the site of spoil stockpiles.

Transmission Lines: Hand-clearing forested wetlands and stream buffers within the transmission-line rights-of-way may cause localized increases in temperature within streams due to the loss of some canopy trees. The presence of shrub vegetation should minimize some of the increase in temperature.

Railroad Culvert Replacement: Potential flooding of short segments of London Creek and adjacent wetlands during the railroad culvert replacement is not expected to affect the chemical or biological content of the water environment.

40 CFR 230.23 Current Patterns and Water Circulation

Current patterns and water circulation are the physical movements of water in the aquatic ecosystem. Currents and circulation respond to natural forces as modified by basin shape and cover, physical and chemical characteristics of water strata and masses, and energy-dissipating factors. The discharge of dredged or fill material may modify current patterns and water circulation by obstructing flow, changing the direction or velocity of water flow and circulation, or otherwise changing the dimensions of a waterbody. As a result, adverse changes may occur in the location, structure, and dynamics of aquatic communities; shoreline and substrate erosion and deposition rates; deposition of suspended particulates; rate and extent of mixing of dissolved and suspended components of the waterbody; and water stratification.

Direct Impacts

Virtually all changes in current patterns and water circulation related to the discharge of fill material will occur as secondary impacts, as explained below.

Secondary Effects

Intake/Refill Structures: The construction of the river intake structure is expected to have minor effects on current patterns and water circulation. During construction, the cofferdam will extend into the Ninety-Nine Islands Reservoir, partially obstructing flow. Some minor scour and bank erosion may occur due to the increased flow velocity. Once the cofferdam is removed, flow is expected to return to preconstruction conditions and any area affected by scour is expected to rehabilitate naturally. The presence of the intake structure is not expected to substantially affect shoreline erosion and accretion patterns. The river intake structure will be nearly flush with the bank of the Ninety-Nine Islands Reservoir in a position where erosion to the bank will be minimized. Intake/refill structures within Make-Up Pond A, Make-Up Pond B, and Make-Up Pond C are not expected to directly affect current patterns or water circulation. Effects on current patterns and water circulation due to the operation of these structures will also be addressed in the NPDES permit for the Lee Nuclear Station under Section 316(b) of the CWA.

Diffuser Structure: Because the diffuser will be attached to the dam, it is not expected to affect current patterns or water circulation. Dredging in the forebay in front of the Ninety-Nine Islands Dam is expected to facilitate mixing from the blowdown discharge and will improve water circulation.

Make-Up Pond A and Make-Up Pond B Dredging: The removal of existing cofferdams and soil outcrops in Make-Up Pond A and Make-Up Pond B is not expected to negatively affect water-circulation patterns within these artificial impoundments. By restoring the natural contours of the area, water circulation may improve within these bodies of water.

Impoundment of Make-Up Pond C: Make-Up Pond C would impound the London Creek system, including headwater drainages, and would alter the water-circulation patterns upstream and downstream of the dam. The presence of Lake Cherokee on London Creek and farm ponds on several headwater tributaries has already altered the existing hydrology of the system to some degree. The impoundment of London Creek will change the drainage from a lotic to a lentic environment upstream of the dam. Approximately 0.6 mi of London Creek will remain between the toe of the dam and the confluence with the Ninety-Nine Islands Reservoir. During operation, London Creek downstream of the dam would continue to receive flow through seepage from the dam, flow down the spillway, and local tributaries (e.g., Little London Creek). Subject to special conditions (to be included in any permit that may be issued) flow commensurate with at least seasonal minimum flow volume will be maintained during construction and while the impoundment is being filled. The net reduction in discharge below the dam would represent restricted stream flows and would affect the downstream transfer of sediments and detritus. However, the transport of these sediments and detritus would likely occur during high flows in the Ninety-Nine Islands Reservoir and the subsequent backwater effect within the London Creek channel. The presence of the existing Ninety-Nine Islands Dam restricts the further transport of such material further downstream within the Broad River system.

50-Ft-Wide Make-Up Pond C Buffer: The mechanical clearing of wetlands and tributaries is not expected to affect current patterns or water circulation.

Borrow Excavation: The excavation of borrow material for the Make-Up Pond C dam may affect the flows of one London Creek tributary, which will ultimately be inundated by Make-Up Pond C. Such long-term impacts are described in the discussion of the effects of the impoundment of Make-Up Pond C.

SC 329 and Construction Roads: Culverts placed during the relocation of SC 329 may alter the flows of tributaries to London Creek. Culverts are already present at these locations for the existing SC 329 and the culverts have been sized to pass adequate flows according to South Carolina Department of Transportation (SCDOT) standards; therefore, no significant impacts on flows are expected. It is possible that temporary culverts placed in tributaries to London Creek for Make-Up Pond C construction roads may temporarily alter the flows of these streams; however, these roads will ultimately be inundated by Make-Up Pond C. Such long-term impacts are described in the discussion of the effects of the impoundment of Make-Up Pond C.

Lake Cherokee Dam and Spillway: Improvements to the Lake Cherokee Dam and emergency spillway are not expected to affect current patterns or water circulation.

Railroad Culvert Replacement: The existing culvert at the railroad crossing of London Creek will be enlarged to a four-cell culvert to improve its capacity. This will reduce temporary inundation on the upstream side of the culvert and high velocities on the downstream side during high flows. During high flood events, backwater from the Broad River stages to a point on London Creek upstream of the culvert. The enlarged capacity will allow more water to pass upstream of the culvert during flooding on the Broad River, and one cell of the culvert will be constructed with engineered streambed material to provide a more natural channel for passage of fish and other aquatic organisms. This culvert replacement will have a beneficial effect on current patterns and water circulation over existing conditions.

Draining from Temporary Cofferdams: The temporary cofferdams associated with the construction of the intake, refill, and diffuser structures will temporarily eliminate the existing water circulation within the area behind the cofferdams. Once the cofferdams are removed, water circulation will be restored.

Draining of Farm Ponds: Draining of farm ponds within the project area will eliminate the existing water circulation within these bodies of open water. Some of these farm ponds will ultimately be inundated by Make-Up Pond C and will be subject to new water-circulation patterns, while other farm ponds will be the sites of spoil material deposition and will cease to function as aquatic systems.

Transmission Lines: Hand-clearing of shrubs and trees within wetlands and riparian buffers within the transmission-line rights-of-way will have no effect on current patterns or water circulation.

Summary: Impacts on current patterns and water circulation will occur primarily as secondary effects. Most components of Lee Nuclear Station will have minor impacts on current patterns and water circulation. The construction of Make-Up Pond C will alter the water-circulation patterns upstream and downstream of the Make-Up Pond C dam. London Creek does not contribute significant volume to the flow of the Broad River and would therefore not significantly affect current patterns or water circulation within the Broad River system. The railroad culvert enlargement will have a beneficial effect on water circulation and flow over current conditions at the railroad crossing of London Creek.

40 CFR 230.24 Normal Water Fluctuations

Normal water fluctuations in a natural aquatic system consist of daily, seasonal, and annual tidal and flood fluctuations in water level. Biological and physical components of such a system are either attuned to or characterized by these periodic water fluctuations.

Direct Impacts

Virtually all changes in water fluctuations related to the discharge of fill material will occur as secondary effects, as explained below.

Secondary Effects

Intake/Refill Structures: The intake/refill structures within Make-Up Pond A, Make-Up Pond B, and Make-Up Pond C will be operated for the purpose of moving water to meet the needs of proposed Lee Nuclear Station Units 1 and 2. Operating the intake/refill structures within Make-Up Pond A would have minimal effect on water levels in that reservoir (see Section 5.3.1.1). However, operating the intake/refill structures within Make-Up Pond B and Make-Up Pond C during drought periods could cause substantial drawdowns of water levels within those reservoirs that could be seasonal in duration. Such drawdowns and their potential effects on abutting wetlands are discussed in Section 5.3.1.1. Such drawdowns and their potential effects on aquatic resources are discussed in Section 5.3.2.1. The operation of the intake/refill structures is detailed in the water-management plan for Lee Nuclear Station (Duke 2011a). The operation of the intakes is regulated under section 316(b) of the CWA.

Diffuser Structure: The diffuser structure is not expected to affect water fluctuations in the Broad River system.

Make-Up Pond A and Make-Up Pond B Dredging: Dredging the existing cofferdams and soil outcrops in Make-Up Pond A and Make-Up Pond B is not expected to affect normal water fluctuations within these impoundments.

Make-Up Pond A and Make-Up Pond B Construction Drawdown: Make-Up Pond A and Make-Up Pond B will be drawn down 20 ft for approximately 32 and 34 months, respectively, during construction of the intake/refill structures and associated cofferdams. During that time, the area of Make-Up Pond A and Make-Up Pond B will be reduced by 28 and 64 ac, respectively (Duke 2012o). Such drawdowns and their potential effects on abutting wetlands are discussed in Section 4.3.1.1. Such drawdowns and their potential effects on aquatic resources are discussed in Section 4.3.2.1.

50-Ft-Wide Make-Up Pond C Buffer: Mechanical clearing of wetlands and streams is not expected to affect normal water fluctuations.

SC 329 and Construction Roads: Culverts placed during the relocation of SC 329 may affect the normal water fluctuation of tributaries to London Creek. Culverts are already present at these locations for the existing SC 329, have been sized to pass adequate flows according to SCDOT standards, and will be countersunk to pass low flows; therefore, no substantial impacts on flows are expected. Temporary culverts placed in tributaries to London Creek for Make-Up Pond C construction roads may alter the natural water fluctuation of these streams; however, these roads will ultimately be inundated by Make-Up Pond C. Long-term impacts of Make-Up Pond C are described in Sections4.2 and 5.2.

Lake Cherokee Dam and Spillway: Improvements to the Lake Cherokee dam and emergency spillway are not expected to affect normal water fluctuations.

Railroad Culvert Replacement: The existing culvert at the railroad crossing of London Creek will be enlarged to improve its capacity. This will reduce temporary inundation on the upstream side of the culvert and help restore more natural water-level fluctuations at this point of the stream. During high flood events, backwater from the Broad River stages to a point on London Creek upstream of the culvert. In addition, the enlarged capacity will allow more water to pass upstream of the culvert during flooding on the Broad River and one cell of the culvert will be constructed with engineered streambed material to provide a more natural channel for passage of fish and other aquatic organisms. This replacement will have a beneficial effect compared to existing conditions.

Draining from Temporary Cofferdams: The temporary cofferdams used to construct the intake, refill, and diffuser structures will temporarily eliminate normal water fluctuations within the area behind the cofferdams. Normal water fluctuation will return once the cofferdams are removed.

Impoundment of Make-Up Pond C: Make-Up Pond C would impound 60,414 linear ft of stream and would reduce the downstream flow of London Creek. The flow pattern of and water fluctuations within London Creek would be permanently altered. London Creek may experience less frequent overbank flood events downstream of the proposed dam, but the remaining segment of London Creek would still receive floodwaters from the backwater effect of the Broad River. Few wetlands downstream of the proposed dam derive their hydrology from overbank flooding from London Creek flows. Floodplain wetlands downstream of the railroad crossing adjacent to London Creek likely derive most of their hydrology from the backwater effects associated with Ninety-Nine Islands Reservoir during flood events. Other wetlands downstream of the dam are associated with Little London Creek, which will not be affected by the impoundment.

Draining of Farm Ponds: Draining the farm ponds will eliminate existing normal water fluctuations within these artificial bodies of water. Some of these farm pond areas will ultimately be re-inundated by Make-Up Pond C, while others will ultimately be the sites of excess spoil disposal.

Transmission Lines: Hand-clearing trees and shrubs within forested wetlands and riparian buffers within the transmission-line rights-of-way will not affect normal water fluctuations.

40 CFR 230.25 Salinity Gradients

Salinity gradients occur where saltwater from the ocean meets and mixes with freshwater from land. This project is located inland and saline habitats will have no effect on salinity gradients.

9.5.3.2 Potential Effects on Biological Characteristics of the Aquatic Ecosystem (Subpart D)

40 CFR 230.30 Threatened and Endangered Species

An endangered species is a plant or animal in danger of extinction throughout all or a significant portion of its range. A threatened species is one in danger of becoming an endangered species in the foreseeable future throughout all or a significant portion of its range. Listings of threatened and endangered species, as well as critical habitats, are maintained by some individual states and by the FWS. The 404 Guidelines specifically state that "where consultation with the Secretary of the Interior occurs under section 7 of the Endangered Species Act, the conclusions of the Secretary concerning the impact(s) of the discharge on threatened and endangered species and their habitat shall be considered final."

As discussed in Sections 4.3.1.6, 4.3.2.3, 5.3.1.3, and 5.3.2.3 of this EIS, FWS concurred with the review team's determination that the proposed Lee Nuclear Station Units 1 and 2 project is not likely to adversely affect Federally protected species nor result in adverse modification to designated or proposed critical habitat, thus completing informal consultation between the FWS and NRC (FWS 2012b). The Georgia aster (*Symphyotrichum georgianum*) is a candidate species for listing under the Endangered Species Act but does not currently receive Federal protection under that law. A small population consisting of 14 stems was observed in an existing transmission-line corridor in the Make-Up Pond C study area in 2009 (see Section 2.4.1.6). This population would be destroyed by the creation of Make-Up Pond C. As described in Section 4.3.1.7, this population of Georgia aster may be relocated to a nearby site of another newly found population or to botanical gardens.

As discussed in Sections 4.3.1.6, 4.3.2.3, 5.3.1.3, and 5.3.2.3 of this EIS, there will be no adverse effect on any State-listed threatened or endangered species. However, as described in Section 4.3.2.3, it is possible that the State-ranked (S1, critically imperiled) Carolina Fantail

Darter (*Etheostoma brevispinum*) could be affected by construction activities at the Broad River intake structure. In addition, populations of five plant species ranked by the State of South Carolina as imperiled or vulnerable (drooping sedge, southern enchanter's nightshade [*Circaea lutetiana* ssp. *canadensis*], southern adder's-tongue fern, Canada moonseed [*Menispermum canadense*], and single-flowered cancer root [*Orobanche uniflora*]) (see Sections 2.4.1.6 and 4.3.1.6) are located in the Make-Up Pond C study area. These populations would be destroyed by the creation of Make-Up Pond C. As described in Section 4.3.1.7, these populations may be relocated to species-specific suitable habitats in an as yet unidentified mitigation area for the Make-Up Pond C site or to botanical gardens.

40 CFR 230.31 Fish, Crustaceans, Mollusks, and Other Aquatic Organisms in the Food Web

Aquatic organisms in the food web include, but are not limited to, finfish, mollusks, insects, annelids, planktonic organisms, and plants and animals upon which they feed or depend. All forms and stages of an organism, throughout its geographic range, are included in this category. The discharge of dredged or fill material can variously affect populations of fish, crustaceans, mollusks, and other food web organisms through the release of contaminants that adversely affect adults, juveniles, larvae, or result in the establishment or proliferation of an undesirable competitive species of plant or animal at the expense of the desired resident species.

Suspended particulates settling on attached or buried eggs can smother the eggs by limiting or sealing off their exposure to oxygenated water. The discharge of dredged or fill material may result in the debilitation or death of sedentary organisms by smothering, exposure to chemical contaminants in dissolved or suspended form, exposure to high levels of suspended particulates, reduction in food supply, or alteration of the substrate upon which they depend. Mollusks are particularly sensitive to the discharge of material during periods of reproduction and growth and development due primarily to their limited mobility. The discharge of dredged or fill material can redirect, delay, or stop the reproductive and feeding movements of some species of fish and crustaceans, thus preventing their aggregation in accustomed places such as spawning or nursery grounds and potentially leading to reduced populations. Reduction of species that feed on detritus or other representatives of lower trophic levels can impair the flow of energy from primary consumers to higher trophic levels. The reduction or potential elimination of food chain organism populations decreases the overall productivity and nutrient export capability of the ecosystem.

<u>Direct Impacts</u>

<u>Intake/Refill Structures</u>: Minor temporary impacts on aquatic organisms will occur during the short duration of construction activities to install the structures. In addition, long-term impacts may result from water withdrawal to various life stages of aquatic organisms during operation. However, impacts associated with water withdrawal during normal operations have been

substantially reduced through the design of an intake that will be screened to minimize the entrainment of egg, larval, and juvenile life stages of aquatic organisms and the impingement of juvenile and adult life stages of aquatic organisms. Further, Section 316(b) of the CWA requires that the intake velocity not exceed 0.5 ft/s to further minimize entrainment and impingement effects. Conditions in the draft NPDES permit for Lee Nuclear Station will require that the intake velocity not exceed 0.5 ft/s. More specifically, two types of screen designs are proposed. The design for the Broad River and Make-Up Pond A intake structures includes dual-flow-type traveling screens with a fish return system. The screens would meet CWA Section 316 (b) requirements (i.e., mesh size 0.375 in. or less and through-screen velocity less than 0.5 ft/s). The Make-Up Pond B and Make-Up Pond C intakes would be passive wedge-wire cylindrical drum screens (proposed range of slot size is 0.079 to 0.374 in. and through-screen velocity less than 0.5 ft/s). While these screen designs do not prevent entrainment of early life stages of fish and shellfish, entrainment impacts would be minimized by compliance with an alternative equivalent to the EPA requirement to limit withdrawal to 5 percent of mean annual flow. Duke's water-management plan proposes to limit withdrawal from the Broad River for refill of Make-Up Pond B and Make-Up Pond C to the months of July through February, thereby minimizing water-volume-related impacts on aquatic biota. In addition, Duke is proposing a closed-cycle cooling system, which could reduce water withdrawal by 96 to 98 percent of the amount that facility would use if it employed a once-through system (66 FR 65256).

Diffuser Structure: Minor temporary impacts on aquatic organisms will occur during the short duration of construction activities to install the structure, including dredging within the Ninety-Nine Islands Reservoir dam forebay. Effects related to the discharge of water during normal operations are regulated and addressed by Section 402 of the CWA. Chemical, physical, and thermal effects are described in Section 5.3.2 and are concluded to be localized and minimal.

Make-Up Pond A and Make-Up Pond B Dredging: Dredging of the existing cofferdams and soil outcrops in Make-Up Pond A and Make-Up Pond B may result in direct mortality of benthic organisms and temporary displacement of some fish species. Upon completion of the dredging, benthic organisms may re-colonize the area. In addition, Dredging will result in localized and temporary increases in turbidity that may have adverse effects on aquatic life. Special conditions requiring implementation of BMPs such as appropriate use of turbidity curtains to minimize these impacts will be included in any Department of the Army permit issued by the USACE and/or Water Quality Certification issued by SCDHEC for the project.

Make-Up Pond C Dam Infrastructure: Because fill for the dam and saddle dikes will eliminate 1929 linear ft of stream and 0.04 ac of wetland (Table 9-20), individuals of some fish and macroinvertebrate species occupying this area will be lost. The construction of the spillway, stilling basin, and riprap will armor 636 linear ft of London Creek. During construction, London Creek will be diverted around the fill placement and armoring, minimizing the direct impact on aquatic species. While sedentary species will not be able to move downstream from the impact area and will be lost, more mobile organisms may move to lower stream reaches after the upstream cofferdam has been constructed.

50-Ft-Wide Make-Up Pond C Buffer: Mechanical clearing and grubbing of the 50-ft-wide buffer of Make-Up Pond C may result in direct mortality impacts on aquatic species within wetlands and streams in the buffer. Secondary effects from turbid conditions may also occur. These aquatic resources will no longer receive shading and will have less habitat value in the altered state.

Borrow Excavation: The excavation of material for the construction of the Make-Up Pond C dam and saddle dikes will result in the elimination of 267 linear ft of tributary to London Creek (Table 9-20). Sedentary organisms that cannot move downstream during excavation will be lost. This area will ultimately be inundated by Make-Up Pond C.

SC 329 and Construction Roads: The relocation of SC 329 will result in permanent direct impacts on 396 linear ft of stream (Table 9-20), removing natural habitat and resulting in the direct loss of sedentary organisms. In general, new culvert constructions will replace existing SC 329 culverts. Since these tributaries exhibit seasonal flow regimes, new culverts can be placed during dry conditions, which should limit direct impacts on motile aquatic organisms. Culverts will be designed to allow for aquatic organism passage such as through the incorporation of countersinking. In general, the downstream ends of these culverts will outfall to the impoundment rather than additional stream habitat.

The roads necessary for the construction of Make-Up Pond C will result in the placement of culverts within 128 linear ft of stream. These culverts will be placed during dry conditions, which should limit direct impacts on motile aquatic organisms. Culverts will not be countersunk because these areas will be ultimately inundated by Make-Up Pond C. The construction roads will result in the placement of fill within 95 linear ft of stream. This area will also be ultimately inundated by Make-Up Pond C.

Lake Cherokee Dam and Spillway: The placement of riprap to stabilize the embankment of the Lake Cherokee dam will result in the elimination of 218 linear ft of stream habitat (Table 9-20), directly affecting organisms that cannot relocate downstream. This area will ultimately be inundated by Make-Up Pond C. Improvements to the Lake Cherokee emergency spillway will result in the placement of riprap within approximately 0.02 ac of Lake Cherokee (Table 9-20), permanently displacing a minor amount of benthic habitat.

Spoil Areas: Spoil stockpiled during the construction of the dam for Make-Up Pond C will result in the loss of 730 linear ft of stream (Table 9-20). Placement of this fill will lead to mortality of aquatic organisms that cannot relocate downstream.

Railroad Culvert Replacement: The replacement of the culvert at the railroad crossing of London Creek will result in the placement of fill material in 5 ft of London Creek and placement of a culvert in 140 linear ft of London Creek. During construction, London Creek will be diverted around the culvert replacement, minimizing the direct impact on aquatic species. While sedentary species will not be able to move downstream from the impact area and will be lost, more mobile organisms may move to lower stream reaches after the upstream cofferdam has been constructed. The box culverts proposed to replace the two existing 120-in.-diameter corrugated metal pipes will improve habitat connectivity upstream and downstream of the crossing; the scour present at the existing crossing prevents upstream movement of aquatic species during most flow events. The proposed replacement is a four-cell culvert of enlarged capacity that will allow more water to pass upstream of the culvert during flooding on the Broad River. One cell of the culvert will be constructed with engineered streambed material to provide a more natural channel for passage of fish and other aquatic organisms.

Secondary Effects

Intake/Refill Structures: Secondary effects on fish, crustaceans, mollusks, and other aquatic organisms may occur due to decreased water volumes in the Broad River associated with refilling Make-Up Pond B and/or Make-Up Pond C after any operational drawdown. Duke's proposed water-management plan (Duke Energy 2011h) would limit withdrawal from the Broad River for refill of Make-Up Pond B and Make-Up Pond C to the months of July through February and is intended to minimize water-volume-related impacts on aquatic biota.

Draining from Temporary Cofferdams: Draining behind the temporary cofferdams used for construction of the intake, refill, and diffuser structures will temporarily remove these areas as aquatic habitat. Any fish or invertebrate species present while water is being removed may experience mortality. Once the cofferdams are removed, these areas will again serve as aquatic habitat.

Inundation of Make-Up Pond C: The inundation of stream within the proposed Make-Up Pond C would result in the conversion of 60,414 linear ft of stream to lentic habitat. Trophic and pollution tolerance analyses conducted by Duke, and referenced in Duke's Supplement to the ER, indicated that the fish and macroinvertebrate communities currently inhabiting London Creek are relatively common (Duke 2009b, 2009c). The 22 fish species sampled within London Creek are consistent with those observed from nearby streams in the Broad River drainage of North Carolina and South Carolina and an SCDNR survey of 10 nearby South Carolina streams. Many of the fish species sampled in London Creek are from the *Centrarchidae* and *Ictaluridae* families and can inhabit both lotic and lentic habitats (Table 2-12) (Coughlan 2009). These species would be expected to maintain or rapidly re-establish even larger populations in the proposed Make-Up Pond C. Benthic macroinvertebrate communities sampled within London Creek were evaluated in the context of bioclassification according to NCDENR methodology. The benthic macroinvertebrate community scored "Fair" during 2008 sampling and “Good–Fair” in 2009. The existing benthic macroinvertebrate community of London Creek will be replaced by a macroinvertebrate community dominated by species adapted to lentic environments. Downstream of the proposed dam, the resulting change in hydrology and nutrient dynamics may change the benthic macroinvertebrate community and other trophic associations of the section of London Creek before the confluence with the Ninety-Nine Islands Reservoir. Given the minor contribution of London Creek to the total flow at Ninety-Nine Islands Reservoir; the absence of minimum flow from Lake Cherokee; and the proposed minimum flow to be maintained below the Make-Up Pond C dam (to commence with filling of the reservoir), any changes in London Creek hydrology or changes in water chemistry downstream of the proposed dam would have minor effects on aquatic communities within the Broad River. No effect is expected on the Smallmouth Bass fishery downstream of Ninety-Nine Islands Dam.

Draining of Farm Ponds: The draining of farm ponds will result in the direct mortality of fish and other aquatic species within the ponds. Prior to draining the ponds, Duke Energy will coordinate with the SCDNR to determine whether fish and other aquatic species can be relocated to other habitats. Some of these farm ponds will be ultimately inundated by Make-Up Pond C and will provide habitat for the same or similar fish community after inundation. Other farm pond areas will be the sites of spoil disposal and will cease to exist as habitat for aquatic species.

Transmission Lines: Hand-clearing of wetlands and riparian buffers within the transmission-line corridors may lead to potential minor increases in temperature over narrow segments of stream (200 to 325-ft-wide rights-of-way [Section 2.2.3.1]). These minor increases may make these short segments of stream undesirable for certain fish and macroinvertebrate species during the summer season. Shade provided by shrubs left in place will minimize the impact.

Railroad Culvert Replacement: Potential, temporary flooding of London Creek and adjacent wetlands during the replacement of the railroad culvert is not expected to substantially affect aquatic species.

40 CFR 230.32 Other Wildlife

Wildlife associated with aquatic ecosystems includes resident and migratory mammals, birds, reptiles, and amphibians. The discharge of fill material and associated impacts (noted in Table 9-20) can result in the loss or change of breeding and nesting areas, escape cover, travel corridors, resting areas, and preferred food sources for resident and migratory wildlife species associated with the aquatic ecosystem. These adverse impacts on wildlife habitat may result from changes in water levels, water flow and circulation, salinity, chemical content, or substrate characteristics and elevation. Increased water turbidity can adversely affect wildlife species that rely upon sight to feed and disrupt the respiration and feeding of certain aquatic wildlife and food chain organisms. The availability of contaminants from the discharge of dredged or fill material may lead to the bioaccumulation of such contaminants in wildlife. Changes in such physical and chemical factors of the environment may favor the introduction of non-native invasive plant and animal species at the expense of native species and communities. In some aquatic environments, lowering plant and animal species diversity may disrupt the normal functions of the ecosystem and lead to reductions in overall biological productivity.

Direct Impacts

The placement of fill associated with the Make-Up Pond C dam, SC 329, spoil areas, and railroad culvert replacement will result in permanent impact on 0.40 ac of wetland (Table 9-20). Less than 0.01 ac of wetland will be affected by mechanical clearing of the 50-ft-wide buffer for Make-Up Pond C. Temporary fill impacts will occur on an additional 0.10 ac of wetland during construction of the railroad culvert replacement and construction roads (Table 9-20). While sedentary species and less motile juveniles will not be able to move out of the impact area and will be lost, more mobile organisms may move to other wetland habitats as fill activities commence. Once temporarily affected wetlands return to former ecological function, wetland-dependent wildlife may repopulate these areas. The placement of fill material, including riprap and culvert material, in association with the Make-Up Pond C dam, SC 329, Lake Cherokee Dam, spoil areas, and the railroad culvert will permanently affect 4375 linear ft of stream (Table 9-20). Mechanical clearing of the 50-ft-wide buffer around Make-Up Pond C will affect 884 linear ft of stream (Table 9-20). Borrow excavation may affect as much as 267 linear ft of stream. Temporary fill for cofferdams during the replacement of the railroad culvert will affect 25 linear ft of stream. Wildlife dependent on streams for part of their lifecycle, such as many amphibians, would lose habitat in these areas. Activities within the open-water areas (e.g., the construction of intake, refill, and diffuser structures) and dredging within Make-Up Pond A and Make-Up Pond B are not expected to affect wildlife due to the localized nature of these activities.

Secondary Effects

Inundation of Make-Up Pond C: A total of 3.22 ac of wetlands will be permanently inundated by the construction of Make-Up Pond C (Table 9-20). In addition, if a 10-year storm event occurs during construction, 0.35 ac of wetlands may be temporarily flooded during the railroad culvert replacement (Table 9-20) because of water impounded by the cofferdams. Approximately 75 percent of the wetland areas in the Make-Up Pond C footprint are classified as having fully functional wildlife habitat, while habitat function for the other 25 percent is classified as ranging from partially impaired to very impaired (Duke 2011h). Thus, although these wetlands are generally small (typically less than 0.1 ac), most of them likely provide suitable habitat for many wetland/riparian species of mammals and birds observed in the London Creek drainage (Section 2.4.1.2). Individuals of these species within the Make-Up Pond C footprint would be lost due to inundation and the new open-water habitat could be used by only a select few of the original species, such as some species of waterfowl and wading birds. Some waterfowl and wading bird species may use suitable open-water and shoreline habitat if it is created as a result of the inundation of Make-Up Pond C. However, the development of suitable habitat is an eventuality that cannot be predicted with any certainty.

All the amphibian (i.e., frogs, toads, salamanders, and newts) species and some reptile species (i.e., all the turtle and some snake species) observed in the London Creek drainage require aquatic habitat during at least a portion of their life cycles (see Section 2.4.1.2). Flooding of wetlands and stream habitat would cause a reduction within the Make-Up Pond C inundation footprint of amphibian and reptile populations. Some of these losses might be partially offset by the later development of wetlands adjacent to Make-Up Pond C. However, this possibility cannot be predicted with any certainty. If wetlands were to develop adjacent to Make-Up Pond C, they would be more likely to become occupied by herpetofauna species adapted to lentic rather than lotic conditions. Consequently, herpetofauna adapted to lotic conditions within the Make-Up Pond C footprint would be lost, but would likely still exist in the stream segments upstream of Make-Up Pond C.

The mammal, bird, and herpetofauna species observed in the project area are common and similar suitable habitat for such species exists in the vicinity. Therefore, impacts on wildlife dependent on stream and wetland environments are not expected to be significant.

<u>Draining of Farm Ponds</u>: Draining the farm ponds within the project area removes a water feature periodically used by some wildlife. While the creation of Make-Up Pond C will provide the equivalent of some of the functions of these farm ponds, wetland compensatory mitigation may also provide open-water areas that would provide some open-water functions in support of wildlife.

<u>Transmission Lines</u>: A total of 1.36 ac of forested wetlands will be cleared by hand for transmission lines on the Lee Nuclear Station site and offsite (Table 9-20) to allow for conductor clearance. The clearing would not disturb wetland soil and will leave shrubs and emergent vegetation in place. Some wildlife may be displaced during the clearing operations. Wildlife species that favor scrub-shrub and herbaceous wetland environments would repopulate the area once the transmission lines are installed (Duke Power Company 1976) and mobile forest wildlife would disperse into similar nearby communities (Section 4.3.1.3).

9.5.3.3 Potential Effects on Special Aquatic Sites (Subpart E)

40 CFR Part 230.40 Sanctuaries and refuges

There are no sanctuaries or refuges in the area.

40 CFR 230.41 Wetlands

Wetlands consist of areas inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

The discharge of dredged or fill material in wetlands is likely to damage or destroy habitat and adversely affect the biological productivity of wetland ecosystems by smothering, dewatering, permanently flooding, or altering substrate elevation or periodicity of water movement. The addition of fill material may destroy wetland vegetation or result in the succession of terrestrial species. Further, it may reduce or eliminate nutrient exchange by reducing the system's productivity or by altering water current patterns and velocities. Disruption or elimination of the wetland system can degrade water quality by obstructing water-circulation patterns that flush large expanses of wetland systems, interfering with filtration function of wetlands, or by changing the aquifer recharge capability of a wetland. In addition, discharges can change the wetland habitat value for fish and wildlife, as discussed in Subpart D. When flow and circulation patterns are disrupted, even an apparently minor loss of wetland acreage may result in major losses in wetland function through secondary impacts. Discharging fill material in wetlands as part of municipal, industrial, or recreational development may modify the capacity of wetlands to retain and store floodwaters and to serve as a buffer zone, shielding upland areas from wave actions, storm damage, and erosion.

<u>Direct Impacts</u>

Fill placed during the construction of Make-Up Pond C will include 0.29 ac of permanent and 0.04 ac of temporary impacts on wetlands, including fill associated with the dam, necessary construction roads within the footprint of the future open-water area, and from the relocation of SC 329 prior to inundation of Make-Up Pond C (Table 9-20). Permanent and temporary fill associated with replacement of the railroad culvert below the Make-Up Pond C dam will involve direct impacts on0.11 and 0.06 ac, respectively (Table 9-20).

<u>Secondary Effects</u>

The creation of Make-Up Pond C will permanently inundate 3.22 ac of wetlands (Table 9-20). The replacement of the culvert at the railroad crossing of London Creek may cause a temporary impact on 0.35 ac of wetland (Table 9-20) if a 10-year storm event occurs during construction. The hand-clearing of tree and shrub vegetation within forested wetlands during the construction of the transmission lines will result in the conversion of 1.36 ac of forested wetland to scrub-shrub or herbaceous wetland (Table 9-20).

Summary

In proportion to the overall resource types within the watershed, the above-noted direct impacts and secondary effects are considered to be minor because of the small area that would be lost. Due to the hydrology of the onsite wetlands, impacts will not substantially disrupt flow and circulation patterns within wetlands.

The loss of wetland functions and values has been minimized through the provision of wetland compensatory mitigation as described in Section 4.3.1.7. Wetland compensatory mitigation would involve wetland credit purchases from a mitigation bank, potential re-establishment of wetlands at Sumter National Forest, and the preservation of wetlands at the Turkey Creek permittee-responsible mitigation site. To further minimize direct and secondary effects related to placement of fill, BMPs will be implemented by Duke (Sections 4.3.1.1 and 4.3.1.3) and will be required as special conditions to be included in any Department of the Army permit that may be issued for this project.

The following procedures and BMPs will minimize the secondary impacts of the discharges to wetlands:

1. Duke will follow and comply with all conditions attached to any Water Quality Certification issued for this project.

2. Prior to beginning any land-disturbing activity, appropriate erosion-control measures (e.g., fences, silt barriers, or other devices) will be placed between the disturbed area and the affected waterway or wetland and maintained in a functioning capacity until the area is permanently stabilized.

3. All necessary measures will be taken to prevent oil, tar, trash, and other pollutants from entering the adjacent offsite areas.

4. Once the project is initiated, it will be carried to completion in an expeditious manner to minimize the period of disturbance to the environment.

5. Upon project completion, all disturbed areas will be permanently stabilized with vegetative cover, riprap, or other erosion-control methods as appropriate.

6. Construction activities will avoid, to the greatest extent practicable, encroachment into any wetland/riverbank areas not designated as impact areas.

7. Construction activities within the Broad River will be minimized during the months of March through June because of potential impacts on fish spawning.

8. To the greatest extent practicable, clearing of riparian vegetation within wetlands and waters of the United States will be conducted manually and low-growing, woody vegetation (e.g., shrubs and saplings) will be left intact to maintain stream bank stability and reduce erosion. Rights-of-way through and adjacent to wetlands will be maintained by hand-clearing rather than with chemicals to reduce the potential for contamination of downstream aquatic resources, to the extent practicable.

9. Vegetation clearing (including timber harvest) and grubbing will be scheduled, to the extent practical, to avoid the migratory bird nesting season (generally March through June).

10. Any riprap used at the project will consist of clean stone or masonry material free of all potential sources of pollution.

11. Except for where indicated on the permit drawings, excavated material will not be stockpiled in the adjacent wetlands, but placed on barges or on high ground, when possible.

12. All excavated materials not used as backfill will be hauled offsite or placed on high ground and properly contained and permanently stabilized to prevent erosion.

13. Only clean earthen material free of all potential sources of pollution will be used as backfill.

14. Any equipment used within wetlands not identified for permanent impact will be equipped with high flotation tires or placed on mats when possible to minimize rutting and compaction.

15. Duke will not encroach into any wetlands or other waters of the United States unless they are identified by the plan set attached to the permit as impact areas.

40 CFR 230.42 Mud Flats

There are no mud flats in the project area.

40 CFR 230.43 Vegetated Shallows

There are no vegetated shallows in the project area.

40 CFR 230.44 Coral Reefs

There are no coral reefs in the project area.

40 CFR 230.45 Riffle and Pool Complexes

Steep gradient sections of streams are sometimes characterized by riffle and pool complexes. Such stream sections are recognizable by their hydraulic characteristics. The rapid movement of water over a coarse substrate in riffles results in a rough flow, a turbulent surface, and high dissolved oxygen levels in the water. Pools are deeper areas associated with riffles. Pools are characterized by a slower stream velocity, a streaming flow, a smooth surface, and a finer substrate. Riffle and pool complexes are particularly valuable habitat for fish and wildlife.

Certain reaches of London Creek contain riffle and pool areas while other areas contain long stretches of sand and silt substrate. Riffle and pool complexes also occur on many of the southern tributaries to London Creek, while these special aquatic sites are generally absent on the northern tributaries that have been affected by past agricultural practices. The functional assessment used in the Charleston District Guidelines for Preparing a Compensatory Mitigation Plan (USACE 2010a) evaluates a ratio of riffles and pools for each stream reach. Of the 67,285 ft of affected streams, approximately 61 percent of the segments have frequent riffles, approximately 16 percent have infrequent riffles, approximately 13 percent have occasional riffles, and approximately 10 percent have no riffles. The presence of these special aquatic sites affects the functional assessment score of the affected stream reach and is therefore incorporated into the determination of required credits for compensatory mitigation.

<u>Direct Impacts</u>

Construction of the proposed Make-Up Pond C dam and associated infrastructure, Make-Up Pond C intake/refill structure, SC 329 relocation, construction roads, Lake Cherokee dam stabilization, railroad culvert, spoil areas, and borrow excavation will result in fill material placed within stream resources. The Make-Up Pond C intake/refill structure, construction roads, Lake Cherokee dam stabilization, and borrow excavation area will all be ultimately inundated by Make-Up Pond C. Riffle-pool complexes are present at the locations of these discharges.

The intake and refill structures at the Lee Nuclear Station site, diffuser structure, and dredging at Make-Up Pond A and Make-Up Pond B are not within riffle-pool complexes and will not affect this type of special aquatic site.

<u>Secondary Effects</u>

<u>Draining from Temporary Cofferdams</u>: These features are not within riffle-pool complexes.

<u>Impoundment of Make-Up Pond C</u>: The impoundment of London Creek will eliminate riffle-pool complexes within the footprint of the impoundment, converting them to lentic habitats. Riffle-pool complexes are present within the impounded segments of stream at a frequency similar to the overall impacts.

<u>Draining of Farm Ponds</u>: The farm ponds are not riffle-pool complexes and draining these resources will have no effect on riffle-pool complexes.

Transmission Lines: Transmission-line crossings have been designed to completely span every stream crossing and no dredged or fill material will be placed within any waters of the United States. Clearing of forest canopy will occur within transmission-line rights-of-ways, but shrub and groundcover vegetation will be maintained with the goal of minimizing sedimentation and erosion impacts in waters of the United States at stream crossings. Impacts to riffle-pool complexes are no expected at transmission-line crossings.

Railroad Culvert Replacement: If a 10-year flood event occurs during construction of the railroad culvert, some riffle-pool complex areas of London Creek will be temporarily inundated. No long-term effect is expected if the area is temporarily inundated.

Summary

The creation of Make-Up Pond C will eliminate riffle-pool complex resources within the footprint of the impoundment. Compensatory wetland and stream mitigation is described in Section 4.3.1.7 and will involve the purchase of mitigation credits from a mitigation bank serving the Broad River watershed, a permittee-responsible mitigation project at the Sumter National Forest involving the restoration of stream habitat, and a permittee-responsible mitigation project involving the preservation and enhancement of high-quality stream resources and associated riparian buffer at the Turkey Creek site. The permittee-responsible mitigation at the Sumter National Forest will result in the creation, restoration, and enhancement of riffle-pool habitat on degraded streams that no longer support such special aquatic sites. To further minimize direct and secondary effects related to placement of fill, special conditions requiring the use of BMPs will be included in any Department of the Army permit that may be issued for this project.

The following procedures and BMPs will minimize the secondary impacts of the discharges to riffle-pool complexes:

- Duke Energy will comply with all conditions attached to any Water Quality Certification issued for this project.
- Prior to beginning any land-disturbing activity, appropriate erosion-control measures (e.g., as fences, silt barriers, or other devices) will be placed between the disturbed area and the affected waterway or wetland, and maintained in a functioning capacity until the area is permanently stabilized.
- All necessary measures will be taken to prevent oil, tar, trash, and other pollutants from entering the adjacent offsite areas.
- Once the project is initiated, it will be carried to completion in an expeditious manner to minimize the period of disturbance to the environment.
- Upon project completion, all disturbed areas will be permanently stabilized with vegetative cover, riprap, or other erosion-control methods as appropriate.

- Construction activities will avoid, to the greatest extent practicable, encroachment into any wetland/stream areas not designated as impact areas.
- To the greatest extent practicable, clearing of riparian vegetation within wetlands and waters of the United States will be conducted manually, and low-growing, woody vegetation (e.g., shrubs and saplings) will be left intact to maintain stream bank stability and reduce erosion.
- Rights-of-way through and adjacent to wetlands will be maintained by hand-clearing rather than with clearing with chemicals to reduce the potential for contamination of downstream aquatic resources, to the extent practicable. Vegetation clearing (including timber harvest) and grubbing will be scheduled, to the extent practical, to avoid the migratory bird nesting season (generally March through June).
- Culverts for SC 329 will be countersunk to provide for low-flow conditions and aquatic organism passage.
- Construction of the dam, the railroad culvert, and SC 329 culverts will be done using pumps to divert the flow of London Creek or subject tributaries. Placement of culverts for temporary construction roads will be accomplished while the streams are in a dry condition.
- Any riprap used at the project will consist of clean stone or masonry material free of all potential sources of pollution.
- Except for where indicated on the permit drawings, excavated material will not be stockpiled in the adjacent wetlands, but placed on barges or on high ground, when possible.
- All excavated materials not used as backfill will be hauled offsite or placed on high ground and properly contained and permanently stabilized to prevent erosion.
- Only clean earthen material free of all potential sources of pollution will be used as backfill.
- Duke Energy will not encroach into any wetlands or other waters of the United States unless they are identified by the plan set attached to the permit as impact areas.

9.5.3.4 Potential Effects on Human Use Characteristics (Subpart F)

40 CFR 230.50 Municipal and private water supplies

Municipal and private water supplies consist of surface water or groundwater directed to the intake of a municipal or private water-supply system. Discharges can affect the quality of water supplies with respect to color, taste, odor, chemical content, and suspended particulate concentration in such a way as to reduce the fitness of the water for consumption. Water can be rendered unpalatable or unhealthy by the addition of suspended particulates, viruses and pathogenic organisms, and dissolved materials. The expense of removing such substances before the water is delivered for consumption can be high. Discharges may also affect the quantity of water available for municipal and private water supplies. In addition, certain commonly used water-treatment chemicals have the potential for combining with some suspended or dissolved substances from dredged or fill material to form other products that can have a toxic effect on consumers.

As described in Sections 5.2.2.1 and 5.2.2.2, this project will affect surface or groundwater supplies by consumptive use for cooling and other operational uses; however, these activities will be regulated under the NPDES permit and municipal and private water supplies will not be affected by construction or operation of this project. Minimum flows for Ninety-Nine Islands Dam established under the FERC license are maintained by the water-management plan for Lee Nuclear Station (Duke 2011a).

40 CFR 230.51 Recreational and commercial fisheries

Recreational and commercial fisheries consist of harvestable fish, crustaceans, shellfish, and other aquatic organisms used by humans. The discharge of dredged or fill material can affect the suitability of recreational and commercial fishing habitat for populations of consumable aquatic organisms. Discharges can result in the chemical contamination of recreational or commercial fisheries. They may also interfere with the reproductive success of recreational and commercially important aquatic species through disruption of migration and spawning areas. The introduction of pollutants at critical times in an aquatic species' life cycle may directly reduce populations of commercially important aquatic organisms or indirectly reduce populations of commercially important aquatic organisms by reducing organisms upon which they depend for food. Any of these impacts can be of short duration or prolonged, depending upon the physical and chemical impacts of the discharge and the biological availability of contaminants to aquatic organisms.

Summary

No commercial fishery exists within the project vicinity. No recreational fishery exists within the London Creek system. The proposed discharge of fill material into wetlands and other waters of the United States would have no noticeable effect on the recreation fisheries in the Ninety-Nine Islands Reservoir or downstream within the Broad River. The discharges from the blowdown diffuser are anticipated to have minimal effect on recreational species within the Broad River and are addressed in Section 5.3.2.1 of the EIS and the NPDES permit under Section 402 of the CWA.

The creation of Make-Up Pond C may help to increase stocks of common recreational fish species. Fish may occasionally pass over the Make-Up Pond C spillway. When fish pass downstream of the Make-Up Pond C dam, this new impoundment could be a source of recruitment to Ninety-Nine Islands Reservoir and the Broad River. Mitigation activities at Sumter National Forest may provide indirect benefits to the Broad River fishery, including the Smallmouth Bass fishery, by improving in-stream habitat and reducing sediment transport to the river.

40 CFR 230.52 Water-related recreation

Water-related recreation encompasses activities undertaken for amusement and relaxation. Activities encompass two broad categories of use: consumptive (e.g., harvesting resources by hunting and fishing) and non-consumptive (e.g., canoeing and sightseeing). One of the more important direct impacts of dredged or fill disposal is to impair or destroy the resources that support recreation activities. The disposal of dredged or fill material may adversely modify or destroy water use for recreation by changing turbidity; suspended particulates; temperature; dissolved oxygen; dissolved materials; toxic materials; pathogenic organisms; quality of habitat; or the aesthetic qualities of sight, taste, odor, and color.

<u>Direct Impacts</u>

Construction of the intake structure on the Ninety-Nine Islands Reservoir would temporarily narrow the reservoir while the cofferdams are in place, but is not expected to affect recreation on the reservoir. Dredge and fill activities for the project are not expected to affect water-related recreation on the Broad River below the Ninety-Nine Islands Dam, which is considered a State Scenic River from the dam to the confluence with the Pacolet River. The water-management plan for the operation of the intake structure ensures that minimum flows will be maintained below the Ninety-Nine Islands Dam during periods of extended drought and it is addressed in the NPDES permit application. Structures associated with the transmission lines, which will be constructed in uplands, will likely not be visible from the river. Construction activities for Make-Up Pond C would not affect water-related recreation at Lake Cherokee.

<u>Secondary Effects</u>

No water-related recreation occurs within London Creek; therefore, no secondary effects are expected due to the creation of Make-Up Pond C.

<u>Summary</u>

Recreation is not expected to be affected by Lee Nuclear Station construction. Compensatory mitigation at Sumter National Forest will improve access across the restored streams for hiking and horseback-riding activities and will provide indirect benefits to the Broad River fishery, including the Smallmouth Bass fishery, by improving in-stream habitat and reducing sediment transport to the river.

40 CFR 230.53 Aesthetics

Aesthetics associated with the aquatic ecosystem consist of the perception of beauty by one or a combination of the senses of sight, hearing, touch, and smell. The aesthetics of aquatic ecosystems apply to the quality of life enjoyed by the general public and property owners. The discharge of dredged or fill material can mar the beauty of natural aquatic ecosystems by degrading water quality, creating distracting disposal sites, inducing inappropriate development, encouraging unplanned and incompatible human access, and by destroying vital elements that contribute to the compositional harmony or unity, visual distinctiveness, or diversity of an area. The discharge of dredged or fill material can adversely affect the particular features, traits, or characteristics of an aquatic area that make it valuable to property owners. Activities that degrade water quality, disrupt natural substrate and vegetational characteristics, deny access to or visibility of the resource, or result in changes in odor, air quality, or noise levels may reduce the value of an aquatic area to private property owners.

Direct Impacts

The construction of Lee Nuclear Station will create temporary adverse impacts on the aesthetics of the area. These impacts will be related to vegetation grubbing and clearing, spoil piles, storage of construction equipment and trailers, forest clear-cutting work, and earthmoving activities. The Lee Nuclear Station site is 0.74 mi from the nearest residence, is not readily visible to motorists from McKowns Mountain Road, and is not open to the public. Structures at the Lee Nuclear Station, which will not be placed within waters of the United States, may be visible from Ninety-Nine Islands Reservoir.

Secondary Impacts

Impoundment of Make-Up Pond C: During construction of Make-Up Pond C, minor and temporary impacts on aesthetics will occur during clearing and grubbing activities. Once Make-Up Pond C has been filled, the presence of this waterbody will represent a beneficial effect to aesthetics in the vicinity, because, in general, most people find waterbodies aesthetically pleasing.

Transmission Lines: Transmission lines for the project will be installed in areas that are rural in nature and will have long-term adverse but minor impacts on residential and agricultural/ commercial properties. As detailed in Section 2.2.3 and summarized above, 31 mi of transmission lines are associated with this project. The transmission lines will not adversely affect the scenic section of the Broad River or any historic properties. The adverse impacts on aesthetics associated with installation of transmission lines will be minor though long-term.

Summary

Minor impacts on aesthetics, primarily due to upland activities, are expected during the construction of Lee Nuclear Station, while the completion of Make-Up Pond C may be seen as a positive benefit to aesthetics. Mitigation activities at Sumter National Forest will improve aesthetics in the subject watershed by restoring incised and eroded banks.

40 CFR 230.54 Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

These preserves consist of areas designated under Federal and State laws or local ordinances to be managed for their aesthetic, educational, historical, recreational, or scientific value. The discharge of dredged or fill material into such areas may modify the aesthetic, educational, historical, recreational, and/or scientific qualities, thereby reducing or eliminating the uses for which such sites are set aside and managed.

<u>Summary</u>

This project includes work on the Lake Cherokee Dam and updating the performance of the emergency spillway. Lake Cherokee is owned and managed by the SCDNR for fishing and boating. All work on SCDNR lands will be coordinated with the SCDNR. As part of this work, Duke will be adding a formal parking area and handicap access to the top of the earthen dam to improve access to this recreational resource. No permanent adverse effects are expected as a result of this work. Some of the compensatory mitigation will occur on Sumter National Forest. Although national forests are not necessarily parks, they have some park-like values and functions. Some temporary effects on the national forest will occur during the restoration work, but the restoration work will provide substantial net benefits to this public resource.

9.5.3.5 Evaluation and Testing (Subpart G)

40 CFR 230.60 and 230.61 General evaluation of dredged or fill material and chemical, biological and physical evaluation and testing

All fill material will be clean material from upland source sites and therefore no testing is required.

10.0 Conclusions and Recommendations

This chapter provides a discussion of the conclusions reached in this environmental impact statement (EIS) and the U.S. Nuclear Regulatory Commission (NRC) staff's recommendations. Section 10.1 summarizes the impacts of the proposed action, Section 10.2 summarizes the proposed project's unavoidable adverse impacts, and Section 10.3 discusses the relationship between the short-term use of resources and long-term productivity of the human environment. Section 10.4 summarizes the irretrievable and irreversible use of resources, and Section 10.5 summarizes the alternatives to the proposed action. Section 10.6 discusses benefits and costs. Section 10.7 includes the NRC staff's recommendation.

By letter dated December 12, 2007, the NRC received an application from Duke Energy Carolinas, LLC (Duke), for combined construction permits and operating licenses (COLs) for two new nuclear reactors at the William States Lee III Nuclear Station (Lee Nuclear Station) site in Cherokee County, South Carolina (Duke 2007a). The proposed Lee Nuclear Station Units 1 and 2 would be owned and operated by Duke (Duke 2009b). With the exception of transmission systems needed to route power from the proposed units and an offsite reservoir (i.e., Make-Up Pond C), all of the construction and operation related to Units 1 and 2 would be completely within the confines of the Lee Nuclear Station site, the unfinished Duke Power Company Cherokee Nuclear Station site (Duke 2009b). The reactors specified in the application are Westinghouse Electric Company, LLC (Westinghouse) Advanced Passive 1000 (AP1000) pressurized water reactors. The application references Revision 19 of the AP1000 certified design (Westinghouse 2011). In November 2011, Duke submitted an application to the U.S. Army Corps of Engineers (USACE) for a Department of the Army individual permit to conduct construction activities that would result in alteration of waters of the United States, including wetlands. The USACE is participating in preparing this EIS as a cooperating agency.

The proposed actions in these applications are (1) NRC issuance of COLs for constructing and operating two new nuclear units at the Lee Nuclear Station site, and (2) USACE issuance of permits pursuant to Section 404 of the Federal Water Pollution Control Act (33 U.S.C. 1344), as amended by the Clean Water Act of 1977 (33 USC 1251 et seq.) (hereafter referred to as the Clean Water Act) to perform certain construction activities on the site.

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. 4321 et seq.) directs that an EIS is required for a major Federal action that significantly affects the quality of the human environment. Section 102(2)(C) of NEPA requires that an EIS include information about the following:

- the environmental impact of the proposed action
- any adverse environmental effects that cannot be avoided should the proposed action be implemented

- alternatives to the proposed action
- the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity
- irreversible and irretrievable commitments of resources that would be involved if the proposed action is implemented.

The NRC has implemented NEPA in Title 10 of the *Code of Federal Regulations* (CFR) Part 51. In 10 CFR 51.20, the NRC requires preparation of an EIS for issuance of COLs. Subpart C of 10 CFR Part 52 contains the NRC regulations related to COLs.

Included in this EIS are (1) the results of the review team's preliminary analyses, which consider and weigh the environmental effects of the proposed action; (2) mitigation measures for reducing or avoiding adverse effects; (3) the environmental impacts of alternatives to the proposed action; and (4) the NRC staff's preliminary recommendation regarding the proposed action based on its environmental review. The USACE will base its evaluation of the Department of the Army individual permit application on the requirements of USACE regulations, Clean Water Act Section 404(b)(1) Guidelines, and the USACE public interest review process. The USACE permit decision will be made following issuance of the final EIS.

The environmental review described in this EIS was conducted by a team consisting of NRC staff, its contractor's staff, and USACE staff. During the course of preparing this EIS, the team reviewed the environmental report (ER) submitted by Duke (2009c) and the supplement to the ER regarding Make-Up Pond C (Duke 2009b); consulted with Federal, State, Tribal, and local agencies; and followed the guidance set forth in the NRC's Environmental Standard Review Plan (ESRP) (NRC 2000a) and *Staff Memorandum Revision 1 - Addressing Construction and Preconstruction, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need for Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in Environmental Impact Statement*s (NRC 2011a). In addition, the NRC considered the public comments related to the environmental review received during the original scoping process in 2008 and the supplemental scoping process related to Make-Up Pond C in 2010. These comments are provided in Appendix D of this EIS. The NRC staff considered public comments received on the draft EIS, which was published in December 2011. The comments and staff responses are provided in Appendix E of this EIS.

As a cooperating agency, the USACE has participated in the environmental review of the proposed action, the public scoping and draft EIS meetings, public comment resolution, and EIS preparation. The proposed action includes impacts on waters of the United States, including wetlands. For actions requiring a Section 404 Clean Water Act permit for the discharge of dredged and/or fill material into waters of the United States, regulations promulgated by the U.S. Environmental Protection Agency (EPA) require USACE to limit its authorization to the least environmentally damaging practicable alternative. The USACE will document its conclusion of the review process, including the requirement for compensatory mitigation in accordance with 33 CFR Part 332, Compensatory Mitigation for Losses of Aquatic Resources, in its permit-decision document.

The proposed source of cooling water and the recipient of effluent for proposed Lee Nuclear Station Units 1 and 2 is the Ninety-Nine Islands Reservoir, which is a feature of the Ninety-Nine Islands Hydroelectric Project, operated by Duke and regulated by the Federal Energy Regulatory Commission (FERC). FERC has requested to be a participating agency in the environmental review of Duke's combined license application for the Lee Nuclear Station (FERC 2011a). Upon receipt of an application from Duke, FERC must conduct a review of Duke's water withdrawal/discharge proposal and accompanying construction activities for the Lee Nuclear Station that occur within the hydroelectric project boundary. Duke expects to apply for necessary FERC permits in 2013.

Following the practice of the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG-1437) (NRC 1996) and supplemental license renewal EISs, environmental issues are evaluated using the three-level standard of significance—SMALL, MODERATE, or LARGE—developed by the NRC using guidelines from the Council on Environmental Quality (CEQ) (40 CFR 1508.27). Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, provides the following definitions of the three significance levels:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Mitigation measures were considered for each environmental issue and are discussed in the appropriate sections. During its environmental review, the review team considered planned activities and actions that Duke indicates it and others would likely take should Duke receive the COLs. In addition, Duke provided estimates of the environmental impacts resulting from building and operating two new nuclear units on the Lee Nuclear Station site.

10.1 Impacts of the Proposed Action

In a final rule dated October 9, 2007 (72 FR 57416), the Commission limited the definition of "construction" to those activities that fall within its regulatory authority (10 CFR 51.4). Many of the activities required to build a nuclear power plant are not part of the NRC action to license the plant. Activities associated with building the plant that are not within the purview of the NRC action are grouped under the term "preconstruction." Preconstruction activities include clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. Because “preconstruction” activities are not part of the NRC action, their impacts are not reviewed as a direct effect of the NRC action. Rather, the impacts of the preconstruction activities are considered in the context of cumulative impacts. In addition, certain preconstruction activities require permits from the USACE, as well as other Federal, State, and local agencies.

Chapter 4 of this EIS describes the relative magnitude of impacts related to preconstruction and construction activities with a summary of impacts in Table 4-7. Impacts associated with operation of the proposed facilities are discussed in Chapter 5 and are summarized in Table 5-20. Chapter 6 describes the impacts associated with the fuel cycle, transportation, and decommissioning. Chapter 7 describes the impacts associated with preconstruction and construction activities and operation of Units 1 and 2 when considered along with the cumulative impacts of other past, present, and reasonably foreseeable future projects in the geographical region around the Lee Nuclear Station site.

10.2 Unavoidable Adverse Environmental Impacts

Section 102(2)(C)(ii) of NEPA requires that an EIS include information on any adverse environmental effects that cannot be avoided should the proposal be implemented. Unavoidable adverse environmental impacts are those potential impacts of the NRC and USACE action that cannot be avoided and for which no practical means of mitigation are available.

10.2.1 Unavoidable Adverse Impacts During Construction and Preconstruction Activities

Chapter 4 discusses in detail the potential impacts from construction and preconstruction of the proposed Lee Nuclear Station Units 1 and 2. Table 10-1 presents the unavoidable adverse impacts associated with construction and preconstruction activities to each of the resource areas evaluated in this EIS and the mitigation measures that would reduce the impacts.

The impact determinations in Table 10-1 are for the combined impacts of construction and preconstruction, unless otherwise noted. For the resources areas of water use, water quality, socioeconomics (with the exception of physical impacts—aesthetics), environmental justice, air quality, nonradiological and radiological health, and nonradioactive waste, the impact determinations for NRC-regulated construction are the same as those for construction and preconstruction combined. The impact determinations for NRC-authorized construction alone and combined construction and preconstruction, are different for land use, aquatic ecology, terrestrial and wetland ecosystems, socioeconomics (only physical impacts—aesthetics), and historic and cultural resources. For these impact determinations that differ, the impacts from the NRC-regulated activities are discussed below the table.

Table 10-1. Unavoidable Adverse Environmental Impacts from Construction and Preconstruction Activities

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Land Use	MODERATE; SMALL for NRC-authorized construction activities	Follow BMPs; minimize encroachment into wetlands and floodplains, use flexibility in transmission-line corridor routing.	Permanent or temporary use of approximately 946 ac on the Lee Nuclear Station site, approximately 1100 ac for Make-Up Pond C, and 987 ac for transmission-line corridors. Minor additional land required for railroad spur and offsite road improvements. Loss of approximately 262 ac of prime farmland and farmland of Statewide importance onsite and for Make-Up Pond C.
Water-Related Impacts			
Water Use	SMALL	No mitigation required.	Impacts on surface-water use would be of limited duration, and peak water demands would represent a small portion of the available water from the Draytonville Water District.
		No mitigation required.	Groundwater would not be used during building, and groundwater-use impacts from dewatering would be limited in magnitude, temporary, and localized.
		No mitigation required.	Groundwater-use effects from filling Make-Up Pond C would be limited to private wells adjacent to the pond. Pumping lift would be reduced when Make-Up Pond C is full, and would be no lower than levels prior to construction when Make-Up Pond C is drawn down.
Water Quality	SMALL	Implement BMPs to control erosion and sedimentation; implement BMPs to ensure dewatering product is discharged with minimal impact to nearby waterbodies; prepare and implement SWPPP to and prevent spills and minimize their impact.	Temporary degradation of surface-water quality due to runoff and erosion. Impacts of filling Make-Up Pond C, discharge of excavation dewatering product, and spills would be localized, temporary, and of limited magnitude.

Table 10-1. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Ecology (Terrestrial)	MODERATE; SMALL for NRC-authorized construction activities	Implement wetland mitigation as required by the USACE; implement mitigation for Federal candidate and State-ranked plant species in coordination with the FWS and the SCDNR, respectively; implement BMPs during preconstruction and construction.	Permanent or temporary losses of 423 ac of forest, permanent clearing of 0.21 ac of forested jurisdictional wetlands, permanent loss of 9.25 ac of non-jurisdictional features, and the temporary drawdown of 5.46 ac of jurisdictional wetlands fringing Make-Up Ponds A and B during an approximate 3-year period on the Lee Nuclear Station site. Permanent or temporary losses of 0.5 ac of forest and 0.52 ac of wetlands along the railroad-spur corridor. Transmission-line corridors would permanently disturb about 690 ac of forest and require permanent clearing of woody vegetation from approximately 1.15 ac of jurisdictional wetlands. Make-Up Pond C would impact about 821 ac of forest (of which about 545 ac are mixed hardwood and mixed hardwood-pine forest along London Creek and its tributaries), and disturb about 3.55 ac of jurisdictional wetlands and about 884 linear ft of forest vegetation along jurisdictional streams.
Ecology (Aquatic)	MODERATE; SMALL for NRC-authorized construction activities	Implement mitigation as required by the USACE. Comply with Federal permits and State 401 water-quality certification. Prepare and implement SWPPP and BMPs to control erosion and sedimentation.	Inundation of London Creek and the formation of Make-Up Pond C would result in the permanent loss of 12.3 mi of creek habitat and in the alteration of 17.58 ac of open-water habitat. There would be an additional permanent loss of 145 ft of tributaries associated with the installation of an enlarged replacement culvert under the existing railroad spur. On the Lee Nuclear Station site, 9.37 ac of open-water habitat would be permanently altered (1.48 ac filled, 7.89 ac dredged). Temporary impacts to aquatic habitat from preconstruction and construction activities (e.g., clearing, filling, drawdowns) include an additional 884 linear ft of tributaries associated with

Table 10-1. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
			the building of Make-Up Pond C, 1345 linear ft of tributaries associated with the culvert replacement project under the existing railroad spur, and 94.68 ac of open-water habitat on the Lee Nuclear Station site.
Socioeconomics			
Physical Impacts	MODERATE; SMALL for NRC-authorized construction activities	None	Developing Make-Up Pond C would involve clearing forested land, which would negatively impact travelers on SC 329 and residents in the vicinity of the Make-Up Pond C site.
Demography	SMALL	None	None
Economic Impacts on the Community	SMALL	None	None
Infrastructure and Community Services	MODERATE for traffic impacts, SMALL for other infrastructure and community service impacts; MODERATE for traffic impacts, SMALL for other infrastructure and community service impacts for NRC-authorized construction activities.	Implement traffic-management plan during site development.	Temporary, highly localized periodic traffic impacts during building.
Environmental Justice	SMALL	None	None
Historic and Cultural	MODERATE; SMALL for NRC-authorized construction activities	Implement MOA and cultural resources management plan between Duke, the	Inundation of Make-Up Pond C would require relocation of the Service Family Cemetery (in coordination with the South Carolina SHPO, in accordance to State law, and in cooperation with

Table 10-1. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
		USACE, South Carolina SHPO, and Catawba Indian Nation including protection of known historic properties and cultural resources, investigations prior to ground-disturbing activities, and procedures for any inadvertent cultural resources discoveries.	descendants) and permanently alter the character, setting, and historic context of this cultural resource.
Air Quality	SMALL	Implement a dust-control plan prior to site preparation that would include dust-mitigation measures. Obtain required air-quality permits from the SCDHEC.	Temporary degradation of local air quality due to vehicle emissions and dust particle emissions during ground clearing, grading excavation activities, and operation of concrete batch plant and other temporary stationary sources.
Nonradiological Health	SMALL	Implement a dust-control plan; adhere to Federal, State, and local emission requirements. Train workers in appropriate safety requirements; adherence to OSHA requirements. Restrict most noise-related activities to daylight hours.	Localized, temporary impacts to public and worker health from dust, exhaust, and construction equipment emissions. Occupational injuries to personnel. Noise from building activities.
Radiological Health	SMALL	Maintain doses to construction workers below NRC public dose limits.	Small doses to construction workers that would be less than NRC public dose limits.

Table 10-1. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Nonradioactive Waste	SMALL	Implement BMPs to minimize waste generation. Manage wastes in accordance with Federal, State, and local requirements. Comply with requirements of NPDES and air quality permits	Creation of construction debris and minor amounts of hazardous wastes. Permitted site stormwater releases to surface water. Minor, localized, and temporary air emissions from construction equipment and temporary stationary sources.

BMPs = Best Management Practices
DOT = U.S. Department of Transportation
FWS = U.S. Fish and Wildlife Service
MOA = Memorandum of Agreement
NPDES = National Pollutant Discharge Elimination System
OSHA = Occupational Safety and Health Administration
SCDHEC = South Carolina Department of Health and Environmental Control
SCDNR = South Carolina Department of Natural Resources
SHPO = State Historic Preservation Office
SWPPP = Stormwater Pollution Prevention Plan
USACE = U.S. Army Corps of Engineers

The NRC staff concludes that the potential unavoidable adverse impacts on land use, terrestrial and wetland ecosystems, aquatic resources, socioeconomics (physical impacts—aesthetics), and historic and cultural resources from construction and preconstruction would be MODERATE; however, the NRC-authorized construction impact for these resource areas would be SMALL. Most unavoidable adverse impacts would be attributable to preconstruction activities associated with onsite facilities outside of the power block, Make-Up Pond C, and the transmission-line corridors. Socioeconomic impacts on infrastructure and community services (traffic) would be MODERATE for both preconstruction and NRC-authorized construction.

Land-use impacts resulting from NRC-authorized construction of Lee Nuclear Station Units 1 and 2 would be SMALL. Much of the land-use demands for building the Lee Nuclear Station project are associated with preconstruction activities such as building Make-Up Pond C and clearing the corridors for the transmission lines.

Impacts to terrestrial and aquatic resources from NRC-authorized construction would be SMALL. Impacts from construction of safety-related facilities for Lee Nuclear Station Units 1 and 2 would be negligible compared to impacts from preconstruction activities.

The impact of NRC-authorized construction on historic and cultural resources would be SMALL. It is unlikely that the historic and cultural resources previously recorded at the unfinished Cherokee Nuclear Station site are preserved given the high levels of earlier ground disturbance. In 2009, 2012, and 2013, the South Carolina SHPO concurred with the determination that proposed onsite activities would not adversely affect historic properties.

The impact of NRC-authorized construction activities on aesthetics in the vicinity of the Lee Nuclear Station site would be SMALL. The Lee Nuclear Station is bounded by woodlands and water features, and the NRC-authorized construction activities would only be visible by those using the Broad River and Ninety-Nine Islands Reservoir.

10.2.2 Unavoidable Adverse Impacts During Operation

Chapter 5 provides a detailed discussion of the potential impacts from operation of the proposed Lee Nuclear Station Units 1 and 2. The unavoidable adverse impacts related to operation are listed in Table 10-2 and are summarized below.

Table 10-2. Unavoidable Adverse Environmental Impacts from Operation

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Land Use	SMALL	None	Continued use of permanent land commitments, including approximately 619 ac of land on the Lee Nuclear Station site, approximately 1050 ac of land for Make-Up Pond C, and 987 ac of land for transmission lines. Minor additional land required for the railroad spur and offsite road improvements.
Water-Related Impacts			
Water Use	SMALL	Surface Water—Comply with SCDHEC NPDES permit requirements and State water withdrawal regulations	Consumptive use of 55 cfs of water withdrawn from the Broad River (3 percent of the mean annual flow).
		Groundwater—None	There would be no use of groundwater during operation. There would be only local and short-term effects on groundwater from drawdown of the makeup ponds during low-river-flow events.

Table 10-2. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Water Quality	SMALL	Surface Water—Comply with SCDHEC NPDES permit requirements	Increased temperature and concentrations of chemicals in cooling-tower blowdown discharged to the Broad River.
		Groundwater—None	There would be no use of groundwater and no discharges to groundwater during operation. The effects of Make-Up Pond C during fill events on water quality in nearby groundwater wells would be similar to existing groundwater quality in the region, temporary, and minor.
Ecology (Terrestrial)	SMALL	Comply with Federal and State permitting requirements; minimize heat-dissipation system impacts; implement BMPs to minimize transmission-line operation and transmission-line and water-pipeline corridor maintenance impacts; operate wastewater treatment basins to minimize potential impacts to avifauna.	Minor impacts of cooling towers; minor impacts of transmission-line operation and transmission-line and water-pipeline corridor maintenance; minor impacts to wetlands from drawdown of cooling-water reservoirs; minor impacts to wildlife from all other plant operations and maintenance activities.
Ecology (Aquatic)	SMALL	Comply with Federal and State permitting requirements; manage frequency and timing of maintenance dredging; comply with SWPPP; implement BMPs (e.g., approved herbicide usage near streams and waterbodies); and manage drawdown and refill of the Make-Up Ponds to minimize potential impacts to aquatic organisms and their habitat in the Broad River and Make-Up Ponds.	Minor impacts to aquatic biota from impingement and entrainment due to cooling-water withdrawal from Ninety-Nine Islands Reservoir, and Make-Up Ponds A, B, and C. Temporary and minor changes to the distribution and abundance of some aquatic species due to thermal, chemical, and physical effects associated with station blowdown into Ninety-Nine Islands; changes to the distribution and abundance of some aquatic species due to

Table 10-2. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
			the operation of the cooling-water reservoirs. Introduction of sediments and pollutants into onsite waterbodies, and impacts from maintenance dredging activities in the Broad River and Make-Up Pond A. Minor disturbance to aquatic resources due to transmission-line-corridor maintenance and operation activities.
Socioeconomics			
Physical Impacts	SMALL	None	Minor impacts on physical road conditions due to increases in traffic at the beginning and end of each operations and outage support shifts.
Demography	SMALL	None	None
Economic Impacts on the Community	SMALL	None	None
Infrastructure and Community Services	SMALL	Implement traffic-management plan, including staggering shifts, to reduce congestion	Minor increase in traffic (i.e., congestion) at the beginning and end of shifts, especially during outage operations
Environmental Justice	SMALL	None	None
Historic and Cultural	SMALL	Implement MOA and cultural resources management plan between Duke, the USACE, South Carolina SHPO, and Catawba Indian Nation including protection of known historic properties and cultural resources, investigations prior to ground-disturbing activities and procedures for any inadvertent cultural resources discoveries	Potential for inadvertent discoveries during maintenance and operational activities

Table 10-2. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Air Quality	SMALL	Cooling towers would be operated with drift eliminators to limit salt deposition. Operation of generators would regulated by SCDHEC air quality permits.	Impact on local aesthetics due to cooling-tower plumes, increased salt deposition in and near the site due to operation of the cooling towers. Criteria pollutants and greenhouse gas emissions from the intermittent use of standby generators and worker vehicles
Nonradiological Health	SMALL	No mitigation beyond strict adherence to NRC and OSHA safety standards	Minimal health impacts from potential exposure to etiologically agents, noise, and acute and chronic electromagnetic fields. Minimal impacts from occupational injuries and transportation of operations workers.
Radiological Health	SMALL	Doses to members of the public would be maintained below NRC and EPA standards; worker doses would be maintained below NRC limits and ALARA; doses to biota other than humans would be maintained below NCRP and IAEA guidelines	Small radiation doses to members of the public, below NRC and EPA standards; ALARA doses to workers; and biota doses less than NCRP and IAEA guidelines
Fuel Cycle (including radioactive waste), transportation, and decommissioning	SMALL[(a)]	Changes in technology are reducing impacts in fuel cycle; implement waste-minimization program; compliance with NRC and DOT regulations.	Small impacts from fuel cycle presented in Table S-3, 10 CFR Part 51. Small impacts from carbon dioxide, radon, and technecium-99. Small radiological doses within NRC and DOT regulations from transportation of fuel and radioactive waste. Small impacts from decommissioning as presented in NUREG-0586 (NRC 2002).

Table 10-2. (contd)

Resource Area	Impact Level	Actions to Mitigate Impacts	Unavoidable Adverse Impacts
Nonradioactive Waste	SMALL	Implement BMPs to minimize waste generation. Manage wastes in accordance with Federal, State, and local requirements. Comply with requirements of NPDES and air quality permits	Small quantities of solid wastes, including hazardous wastes; permitted effluents discharged to the Broad River; temporary and occasional emissions from backup generators

(a) This conclusion is conditional on the results of the ongoing rulemaking to update the Waste Confidence Decision and Rule (see Section 6.1.6).

ALARA = As Low As Reasonably Achievable
APLIC = Avian Power Line Interaction Committee
BMPs = Best Management Practices
cfs = cubic feet per second
EPA = U.S. Environmental Protection Agency
IAEA = International Atomic Energy Agency
MOA = Memorandum of Agreement
NCRP = National Council on Radiation Protection & Measurements
NPDES = National Pollutant Discharge Elimination System
OSHA = Occupation Safety and Health Administration
SCDHEC = South Carolina Department of Health and Environmental Control
SHPO = State Historic Preservation Officer
SWPPP = Stormwater Pollution Prevention Plan
USACE = U.S. Army Corps of Engineers

Consumptive water use of about 55 cfs and thermal discharge to the Broad River are unavoidable adverse impacts from operation of Lee Nuclear Station Units 1 and 2. The review team determined that 55 cfs would represent only about 3 percent of the Broad River mean annual flow, and river water temperature would increase only 1.1 and 1.2°F in January and August, respectively. Stormwater would be managed with a site-specific SWPPP and operations-related monitoring would be performed to ensure that cooling-tower blowdown would comply with requirements contained in the Lee Nuclear Station NPDES permit.

Unavoidable adverse impacts to terrestrial resources would include minor impacts of cooling towers on birds (collisions and noise) and native and ornamental vegetation (drift deposition). Additional impacts are briefly described below:

- minor impacts from transmission-line operation on birds (collisions and electrocutions) and transmission-line- and water-pipeline corridor maintenance (vegetation cutting and herbicide use) on wildlife and important habitats, including floodplains and wetlands (vegetation cutting)

- minor impacts from drawdown on existing wetlands around Make-Up Pond B and wetlands that could develop around Make-Up Pond C
- minor impacts to wildlife from increased traffic, water-treatment-basin operation, railroad-spur operation, nighttime security lighting, and electromagnetic fields
- minor impacts to habitat and wildlife from dredged material disposal.

Unavoidable adverse aquatic impacts would include impingement and entrainment loss of organisms at the Broad River and Make-Up Pond intakes, and loss of benthic organisms during dredging activities. These adverse impacts would be minimal during operation because the intake structures on Ninety-Nine Islands Reservoir and Make-Up Ponds A, B, and C, would be designed and located to minimize effects to aquatic organisms from impingement and entrainment. Aquatic impacts from station blowdown to the Ninety-Nine Islands Reservoir and the Broad River below Ninety-Nine Islands Dam also would have minimal effects to aquatic organisms because of design and placement of the discharge pipe multiport diffuser and rapid mixing of the station blowdown with the river water through Ninety-Nine Islands Dam. Operation of the intake and discharge structures would comply with the Lee Nuclear Station NPDES permit.

Unavoidable adverse socioeconomic impacts likely would be similar to those during the building phase but would be much smaller because project-related population would be smaller and much of the mitigation of housing and infrastructure shortages would have occurred in response to the larger impacts during the building period. Adverse socioeconomic impacts primarily would be increased traffic, some damage to roads, and an increase in the demand for housing and public services.

Unavoidable adverse impacts to historic and cultural resources would be insignificant under consistent implementation of the cultural resources management plan and MOA between Duke, the USACE, the South Carolina SHPO, and the Catawba Indian Nation (USACE et al. 2013). The MOA is tailored specifically for the Lee Nuclear Station and associated developments.

Unavoidable adverse air-quality impacts would be negligible and pollutants emitted during operations would be insignificant. Duke would comply with applicable air permits issued by SCDHEC. Radiological health impacts would also be minimal. Doses to members of the public and workers would be maintained below NRC and EPA standards and ALARA. Doses to biota other than humans would be maintained below NCRP and IAEA guidelines.

Nonradiological health impacts to members of the public from operation, including exposure to etiological agents, noise, electromagnetic fields, and increased impacts from transportation of materials and personnel to and from the Lee Nuclear Station site would be minimized through controls and measures by Duke associated with compliance with Federal and State regulations. Creation of solid waste and small quantities of nonhazardous waste and discharge of stormwater and cooling-tower blowdown would be small but unavoidable impacts from operation of the proposed Lee Nuclear Station Units 1 and 2. Implementation of a waste-minimization plan, including an aggressive recycling program, would reduce impacts from solid and hazardous wastes. Duke would comply with State and Federal regulations regarding waste and discharge of liquid effluents.

Impacts from the nuclear fuel cycle would be bounded by the impacts in presented in Table S–3 of 10 CFR Part 51, and are therefore small. Impacts from carbon dioxide, radon, and technetium-99 were not addressed in Table S–3; Section 6.1 of this EIS addresses those impacts and concludes that they are small. Radiological doses from transportation of fuel and radwaste would be within NRC and DOT regulations and therefore small. Impacts from decommissioning are addressed in Section 6.3 of this EIS; they are also consistent with the impacts presented in NUREG-0586, and are therefore small.

10.3 Relationship Between Short-Term Uses and Long-Term Productivity of the Human Environment

Section 102(2)(C)(iv) of NEPA requires that an EIS include information on the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity.

The local use of the human environment by the proposed project can be summarized in terms of the unavoidable adverse environmental impacts of building and operation and the irreversible and irretrievable commitments of resources. With the exception of the consumption of depletable resources as a result of plant building and operation, these uses may be classed as short-term. The principal short-term benefit of the plant is the production of electrical energy. The economic productivity of the site, when used for this purpose, would be extremely large compared to the productivity from agriculture, mining, or from other probable uses for the site.

The maximum long-term impact on productivity would result if the plant were not immediately dismantled at the end of the period of plant operation, and consequently, the land occupied by the plant structures would not be available for other uses for an extended period of time that would depend on the delay in dismantlement. However, the enhancement of regional productivity resulting from electrical-energy production by the plant is expected to result in a correspondingly large increase in regional long-term productivity that would not be equaled by other long-term uses of the site. In addition, most long-term impacts resulting from land-use preemption by plant structures can be eliminated by removing these structures or by converting them to other productive uses. Once the units are shut down, they would be decommissioned according to NRC regulations. Once decommissioning is complete and the NRC license is terminated, the site would be available for other uses.

The review team concludes that the negative aspects of plant construction, preconstruction, and operation as they affect the human environment are outweighed by the positive long-term enhancement of regional productivity through the generation of electrical energy.

10.4 Irreversible and Irretrievable Commitments of Resources

Section 102(2)(C)(v) of NEPA requires that an EIS include information on any irreversible and irretrievable commitments of resources that would occur if the proposed actions are implemented. The term “irreversible commitments of resources” refers to environmental resources that would be irreparably changed by the new units and that could not be restored at some later time to the resource’s state before the relevant activities. “Irretrievable commitments of resources” refers to materials that would be used for or consumed by the new units in such a way that they could not, by practical means, be recycled or restored for other uses. Irreversible commitments of resources are the environmental resources discussed in Chapters 4, 5, and 6 of this EIS.

10.4.1 Irreversible Commitments of Resources

Irreversible commitments of environmental resources resulting from Lee Nuclear Station Units 1 and 2, in addition to the materials used for the nuclear fuel, are described in the following sections.

10.4.1.1 Land Use

Land committed to the disposal of radioactive and nonradioactive wastes is committed to that use, and cannot be used for other purposes. The land used for the proposed Lee Nuclear Station, with the exception of any filled wetlands or waters of the United States, would not be irreversibly committed because once proposed the Lee Nuclear Station ceases operations and the plant is decommissioned in accordance with NRC requirements, the land supporting the facilities could be returned to most other industrial or nonindustrial uses. Make-Up Pond C could be drained and returned to its previous use. However, prime farmland soils inundated or otherwise disturbed to create Make-Up Pond C could be irretrievably altered.

10.4.1.2 Water Use

Under average conditions, 24,638 gpm (55 cfs) of surface water used as cooling water would be lost through evaporation (i.e., referred to as consumptive use) during operation. There would be no use of groundwater and no discharge to groundwater during operation.

10.4.1.3 Ecological Resources

Preconstruction and construction in the terrestrial environment would affect about 946 ac of terrestrial habitat on the Lee Nuclear Station site, about 1100 ac of offsite terrestrial habitat for Make-Up Pond C, and about 778 ac of offsite terrestrial habitat for the transmission lines. Some of the losses would be only temporary while facilities are under development, while other losses would be more permanent, at least for the operational life of the Lee Nuclear Station project. The specific composition of the habitat losses, as well as information on wetland losses and possible effects on important species, are provided in Section 4.3.1. Of particular note, the loss of habitat at Make-Up Pond C would permanently reduce wildlife populations in the London Creek watershed and the functionality of the watershed as a wildlife travel corridor.

Plant operations in the terrestrial environment would have the following effects. Cooling towers would have minor impacts on birds (collisions and noise) and native and ornamental vegetation (drift deposition). Transmission-line operation would have minor impacts on birds (collisions and electrocutions). Transmission-line and water-pipeline corridor maintenance (vegetation cutting and herbicide use) would have a minor impact on wildlife and important habitats, including floodplains and wetlands (vegetation cutting). Drawdown would have minor impacts on existing wetlands around Make-Up Pond B and wetlands that could develop around Make-Up Pond C. Increased traffic, water-treatment-basin operation, railroad-spur operation, nighttime security lighting, and electromagnetic fields would have minor impacts on wildlife. Disposal of dredged material would have minor impacts on habitat and wildlife.

Preconstruction and construction in the aquatic environment would result in a permanent change to an estimated 9.37 ac of open water on the Lee Nuclear Station site. Building Make-Up Pond C would result in permanent effects on an estimated 17.58 ac of open water and 64,911 linear ft of stream offsite. Additional temporary impacts would be necessary and are discussed in Section 4.3.2. Building Make-Up Pond C would fundamentally alter the physical and biological characteristics of London Creek, a tributary to the Broad River. Most lotic (stream) species in London Creek that are adapted to flowing water would be replaced with lentic (lake) species adapted to the still waters of the supplemental cooling-water reservoir. Plant operations in the aquatic environment would also affect aquatic biota, but are not expected to result in permanent change to aquatic resources. The cessation of water withdrawal from and discharge to the Broad River and Make-Up Ponds A, B, and C, and the end of transmission-line maintenance once plant operations cease, would benefit aquatic resources.

10.4.1.4 Socioeconomic Resources

The staff expects that no irreversible commitments would be made to socioeconomic resources because they would be reallocated for other purposes once the plant is decommissioned.

10.4.1.5 Historic and Cultural Resources

Cultural resource attributes would be permanently altered by the construction, preconstruction, and operation of proposed Lee Nuclear Station Units 1 and 2, Make-Up Pond C, transmission lines, and the railroad spur. Almost all impacts would be attributable to preconstruction activities, particularly those for Make-Up Pond C. The Service Family Cemetery would be relocated prior to impoundment of London Creek and inundation of the Make-Up Pond C area, permanently altering the cultural setting of this cultural resource and its relationship to regional history, settlement patterns, and the historical uses of the land. Under consistent implementation of the cultural resources management plan and MOA between Duke, the USACE, the South Carolina SHPO, and the Catawba Indian Nation (USACE et al. 2013), the staff expects no additional irreversible commitments of historic and cultural resources.

10.4.1.6 Air and Water Resources

Dust and other emissions (e.g., vehicle exhaust) would be released to the air during construction and preconstruction. During operations, vehicle exhaust emissions would continue and other air pollutants and chemicals, including very low concentrations of radioactive gases and particulates, would be released from the facility to the air and surface water. The staff expects no irreversible commitment to air or water resources because all proposed releases at Lee Nuclear Station Unit would be made in accordance with duly issued permits.

10.4.2 Irretrievable Commitments of Resources

Irretrievable commitments of resources during construction of the proposed Lee Nuclear Station generally would be similar to that of any major construction project. A study by the U.S. Department of Energy (DOE) (DOE 2004) of new reactor construction estimated that the following quantities of materials would be required for the reactor building of a typical new 1300-MW(e) nuclear power unit: 12,239 yd^3 of concrete, 3107 tons of rebar, and 6,500,000 ft of cable. An estimated additional 275,000 ft of piping would be required for a two-unit plant. A total of approximately 182,900 yd^3 of concrete and 20,512 tons of structural steel would be required to construct the reactor building, major auxiliary buildings, the turbine-generator building, and the turbine-generator pedestal. Therefore, about twice these amounts would be needed for building two units at the Lee Nuclear Station site, and more resources would be required for other site structures.

The review team expects that the use of construction materials in the quantities associated with those expected for the Lee Nuclear Station, while irretrievable, would be of small consequence with respect to the availability of such resources.

The main resource that would be irretrievably committed during operation of the new nuclear units would be uranium. The availability of uranium ore and existing stockpiles of highly enriched uranium in the United States and Russia that could be processed into fuel is sufficient (OECD NEA and IAEA 2008) so that the irreversible and irretrievable commitment of this resource would be negligible.

10.5 Alternatives to the Proposed Action

Alternatives to the proposed action are discussed in Chapter 9 of this EIS. Alternatives considered include the no-action alternative, energy-production alternatives, system-design alternatives, and alternative sites. For the purposes of evaluation undertaken by the USACE, possible alternative facility layouts on the proposed site also are addressed.

The no-action alternative, described in Section 9.1, refers to a scenario in which the NRC would deny the request for COLs or the USACE would deny Duke's permit request. In either case, construction of the two new units would not proceed as proposed. If no other power plant were built or electrical power supply strategy was implemented to replace the proposed action, the electrical capacity to be provided by the project would not become available, and the benefits (electricity generation) associated with the completed project would not occur, and the need for power would not be met. Failure to supply the needed electricity would have significant adverse impacts within the region of interest and the staff expects that the Public Service Commission of South Carolina and the North Carolina Utilities Commission would take steps to confirm that the need for power would be met.

Alternative energy sources are described in Section 9.2 of this EIS. Alternatives not requiring additional generating capacity are described in Section 9.2.1. Alternatives requiring new generating capacity, including detailed analyses of coal-fired and natural-gas-fired alternatives, are provided in Section 9.2.2. Other energy sources, including renewable energy sources, are discussed in Section 9.2.3, and a combination of energy alternatives (involving a combination of fossil fuel and renewable energy generation sources) is discussed in Section 9.2.4. The review team concluded by comparative analysis presented in Section 9.2.5 that none of the alternative power production options are environmentally preferable to the proposed action.

Alternative sites are discussed in Section 9.3 of this EIS. Cumulative impacts in the vicinity of the Lee Nuclear Station site, including the proposed Lee Nuclear Station Units 1 and 2 and Make-Up Pond C, are compared with the cumulative impacts from building and operating the same physical facilities and adequate offsite reservoirs at each of the alternative sites. Section 9.3.6 (Table 9-18) summarizes the NRC staff's characterization of cumulative impacts at the proposed and alternative sites. Based on this review, the NRC staff concludes that none of the alternative sites is environmentally preferable or obviously superior to the Lee Nuclear Station site. The NRC's determination is independent of the USACE's determination of a least environmentally damaging practicable alternative pursuant to Clean Water Act Section 404(b)(1) Guidelines. The USACE will conclude its analysis of both offsite and onsite alternatives in its Record of Decision.

Alternative system designs, focusing on alternative cooling-system designs, are discussed in Section 9.4 of this EIS. Section 9.4.1.6 details the review team's independent analysis of a combination wet/dry cooling-tower system as a way to limit consumption of cooling-water and potentially obviate the need for Make-Up Pond C. The staff determined that none of the alternative system designs are environmentally preferable to the proposed design.

10.6 Benefit-Cost Balance

A principal objective of NEPA is to require each Federal agency to consider, in its decision-making process, the environmental impacts of each proposed major action and the available alternative actions, including alternative sites. In particular, as stated below, NEPA requires all Federal agencies to the fullest extent possible provide the following:

> "(B) identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by Title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations."

However, neither NEPA nor CEQ requires the benefits and costs of a proposed action be quantified in dollars or any other common metric.

The intent of this section is not to identify and provide monetary estimates of all the potential societal benefits of the proposed project and compare these to a monetized estimate of the potential costs of the proposed project. Instead, this section focuses on monetized values for only those activities closely related to the building and operation of the proposed new units. For other benefits and costs of such magnitude or importance that their inclusion in this analysis can inform the NRC and USACE decision-making processes, the review team offers quantified assessments. This section compiles and compares the pertinent analytical conclusions reached in earlier chapters of this EIS. It gathers all of the expected impacts from building and operating the proposed Lee Nuclear Station Units 1 and 2 and aggregates them into two final categories: (1) the expected environmental costs and (2) the expected benefits to be derived from approval of the proposed action. As such, the analysis includes the costs and benefits of both preconstruction activities and NRC-authorized construction and operations activities.

Although the analysis in this section is conceptually similar to a purely economic benefit-cost analysis, which determines the net present dollar value of a given project, the intent of this section is to identify potential societal benefits of the proposed activities and compare these to the potential internal (i.e., private) and external (i.e., societal) costs of the proposed activities. The purpose is to generally inform the COL process by gathering and reviewing information that demonstrates the likelihood the benefits of the proposed activities outweigh the aggregate costs.

General issues related to Duke's financial viability are outside NRC's mission and authority, and thus are not considered in this EIS. Issues related to the financial qualifications of the applicant will be addressed in the staff's safety evaluation report. It is not possible to quantify and assign a value to all benefits and costs associated with the proposed action. This analysis, however, attempts to identify, quantify, and provide monetary values for benefits and costs when reasonable estimates are available.

Section 10.6.1 discusses the benefits associated with the proposed action. Section 10.6.2 discusses the costs associated with the proposed action. A summary of benefits is shown in Table 10-3. In accordance with NRC guidance in NUREG-1555 (NRC 2000a), internal costs of the proposed project are presented in monetary terms. Internal costs include all of the costs included in a total capital cost assessment (i.e., direct and indirect cost of construction, plus the annual costs of operation and maintenance). Section 10.6.3 provides a summary of the impact assessments, bringing previous sections together to establish a general impression of the relative magnitude of the proposed project's benefits and costs.

10.6.1 Benefits

The most apparent benefit from building and operating a power plant is that it would eventually generate power and provide thousands of residential, commercial, and industrial consumers with electricity. Maintaining an adequate supply of electricity in any given region has social and economic importance because adequate electricity is the foundation for economic stability and growth, and is fundamental to maintaining the current standard of living in the United States. Because the focus of this EIS is on the generating capacity of the proposed Lee Nuclear Station Units 1 and 2, this section focuses primarily on the relative benefits of the Lee Nuclear Station option rather than the broader, more generic benefits of electricity supply.

10.6.1.1 Societal Benefits

For the production of electricity to be beneficial to a society, a corresponding demand, or "need for power," must exist in the region. Chapter 8 defines and discusses the need for power in more detail. From a societal perspective, availability, long-term price stability, energy security, and fuel diversity are the primary benefits associated with nuclear power generation relative to most other alternative generating approaches. These benefits are described in this subsection.

Price Stability and Longevity

Because of relatively low and nonvolatile fuel costs (i.e., approximately 0.5 cents per kWh) and projected capacity utilization rate of 93 percent, nuclear energy is a dependable electricity resource that can be provided at relatively stable prices to the consumer over a long time period. Nuclear power facilities generally are not subject to fuel price volatility like natural-gas-fired and coal-fired power plants. In addition, uranium fuel constitutes only 3 to 5 percent of the cost of a kilowatt-hour (kWh) of nuclear-generated electricity. Doubling the price of uranium increases the cost of electricity by about 7 percent. Doubling the price of natural gas would add about 70 percent to the price of electricity, and doubling the cost of coal would add about 36 percent to the price of electricity (WNA 2010).

Table 10-3. Benefits of Lee Nuclear Station

Benefit Category	Description of Benefit	Value of Benefit Over License Period
	Net Electrical Generating Benefits	
Generating capacity (two plants)	Approximately 2234 MW(e)	-
Electricity generated (two plants operating at 93% capacity)	18,200,000 MWh	-
Taxes and Other Revenue During Plant Construction, Preconstruction, and Operation Period (transfer payments – not independent benefits)		
Annual property taxes	Approximately $11.8 million in fee-in-lieu-of-payments annually	$11.8 million a year
	Effects on Regional Productivity	
Construction workers	Direct Impact: Approximately 4613 workers at project peak Indirect Impact: Approximately 1991 indirect jobs supported by the direct workforce in Cherokee and York Counties	
Operational workers	Direct Impact: 957 workers added over 40-year life of plant Indirect Impact: Approximately 1115 indirect jobs supported by the direct workforce in Cherokee and York Counties	
Technical and other non-monetary benefits	Fuel diversity reduces the risk associated with reliance on any single fuel source	
Electric reliability	Enhances electric grid reliability and stability	
Price volatility	Dampens potential for fuel price volatility	

Energy Security and Fuel Diversity

Currently, more than 70 percent of the electricity generated in the United States is generated with fossil-based technologies; thus, non-fossil-based generation, such as nuclear generation, is essential to maintaining diversity in the aggregate power generation fuel mix (DOE/EIA 2011). Nuclear power contributes to the diverse U.S. energy mix, hedging the risk of shortages and price fluctuations for any one generating system and reducing national dependence on imported fossil fuels.

As described in Chapter 8 of this EIS, the NRC staff analysis of the relevant load forecasts revealed a need for power of approximately 4,300 MW in the region of interest by the year 2027. The proposed Lee Nuclear Station Units 1 and 2 would generate approximately 2234 MW(e) net, which would help meet this baseload need in the region. Assuming a reasonably low capacity factor of 85 percent, the plant's average annual electrical-energy generation would be about 16,400,000 MWh. A reasonably high-capacity factor of 93 percent would result in slightly more than 18,200,000 MWh of electricity.

10.6.1.2 Regional Benefits

Regional benefits of the building and operation of proposed Lee Nuclear Station include enhanced tax revenues, regional productivity, and community impacts.

Tax Revenue Benefits

Revenues would accrue to the State and the two-county economic impact area primarily in the form of property, income, and sales taxes over a short-term period due to building activities and over a long-term period due to operation activities. Duke (2009c) has agreed to pay Cherokee County $11.8 million annually in property taxes during the first 30 years of the operating life of the proposed Lee Nuclear Station (upon completion and operation of the proposed units).

In addition to property taxes, building-related jobs and salaries would generate State income tax revenue. The review team assumed that 70 percent of the skilled crafts workforce would relocate into the region while the plant is being built. However, impacts in the state would occur only to the degree that construction and operations workers would be relocating from out of state or when in-state workers significantly upgrade their disposable income compared to previous in-state employment. The review team concludes, when viewed in the context of total sales tax revenue to the State of South Carolina, the net impact on sales tax revenue caused by potential relocations to South Carolina, or from the effect of upgrading disposable income through better employment, would be minimal.

Sales taxes would be levied on materials purchased in-state to build proposed Lee Nuclear Station Units 1 and 2. Retail sales of tangible personal property are subject to general State sales or use taxes of 6.0 percent. In addition, the counties collect an additional 1.0 percent in local sales and use taxes, bringing the total rate to 7.0 percent.

Regional Productivity and Community Impacts

Proposed Lee Nuclear Station Units 1 and 2 would require a peak-level workforce of approximately 4613. The long-term impact would be realized from the operations employment multiplier effect which suggests that 1115 additional indirect and induced jobs would be created to support the 957 direct jobs during the operations period. The economic multiplier effect of the increased spending by the direct and indirect workforce created as a result of the proposed Lee Nuclear Station would increase the economic activity in the region, most noticeably in Cherokee

County. Sections 5.4.3.1 and 4.4.3.1 provide additional information on the economic impacts of building and operating the proposed Lee Nuclear Station.

The NRC staff's interviews in communities surrounding the Lee Nuclear Station site revealed that the public perceives Duke as a "good corporate citizen," and believes there would be a benefit to the region from the presence of significant groups of relatively well-paid and well-educated employees associated with development of a nuclear power facility. Local officials and service organization representatives all emphasized the philanthropic and service value that Duke and its employees bring to the community (NRC and PNNL 2008).

10.6.2 Costs

Internal costs to Duke, as well as external costs to the surrounding region and environment, would be incurred during preconstruction, construction, and operation of the proposed Lee Nuclear Station. Internal costs include the costs to physically construct the nuclear power facility (capital costs), as well as operating and maintenance, fuel, waste disposal, and decommissioning costs. External costs include all costs imposed on the environment and region surrounding the facility that are not internalized by the company and may include such things as a loss of regional productivity, environmental degradation, or loss of wildlife habitat. The external costs listed in Table 10-4 summarize environmental impacts to resources that could result from preconstruction, construction, and operation of proposed Lee Nuclear Station. Because Table 10-4 includes costs for preconstruction activities as well as for NRC-authorized construction and operation, the costs presented for an individual resource may be greater than the costs solely for the NRC-authorized portion of the project.

Table 10-4. Internal and External Costs of the Proposed Project

Cost Category	Description of Cost
Internal Costs	
Construction Costs (overnight cost) for both units (including preconstruction costs)	$11 billion (about $4900 per installed kW(e)) (Duke 2009c)
Transmission lines	$269 million (about $122 per installed kW(e)) (Duke 2009c)
External Costs	
Operations	1.7 to 3.7 cents per kWh (Duke 2009c) 6.6 to 11.1 cents per kWh (MIT 2009 and The Keystone Center 2007)
Fuel cost	0.45 cents per kWh (WNA 2010)
Decommissioning	Approximately $1.032 billion (Duke 2013a)

Table 10-4. (contd)

Cost Category	Description of Cost
Land and land use	MODERATE. The proposed Lee Nuclear Station Units 1 and 2 would occupy approximately 619 ac permanently and 327 ac temporarily on the 1928-ac site. Part of the land proposed to be used by new structures was cleared during previous reactor development work at the site. An additional 2110 ac of land is being purchased for the Make-Up Pond C site. Existing structures, including 86 houses, were removed. Approximately 1100 ac of the proposed Make-Up Pond C land parcel would be permanently or temporarily occupied (mostly permanent). Approximately 262 ac of prime farmland and farmland of Statewide importance could be disturbed or otherwise excluded from future agricultural use. In addition, approximately 987 ac of land would be permanently occupied by the proposed new transmission-line corridors, although agricultural land uses would be allowed in most of the right-of-way. Small areas of additional land would be occupied by the proposed railroad spur and other minor utilities. (See Sections 4.1 and 5.1.)
Hydrological and water use	SMALL. Some costs would be associated with providing water for various needs during construction, preconstruction, and operation. There would be no use of groundwater during construction, preconstruction, or operation. Cooling water would be taken from the Broad River. About 24,638 gpm (55 cfs) would be lost though evaporation. Relatively small levels of pollutants and/or radioactive effluents would be introduced into the Broad River. A small thermal plume would result from cooling-tower blowdown discharged to the Broad River. (See Sections 4.2 and 5.2.)

Table 10-4. (contd)

Cost Category	Description of Cost
Terrestrial habitats and species	MODERATE for preconstruction impacts in the terrestrial environment. Impacts at the Lee Nuclear Station site would include permanent or temporary losses of forests (approximately 423 ac of forest cleared), jurisdictional wetlands (0.21 ac of forested wetlands hand cut), and non-jurisdictional features (9.25 ac of water-filled depressions filled), as well as the temporary drawdown of 5.46 ac of jurisdictional wetlands during an approximate 3-year period. Permanent losses would occur on 0.5 ac of forest and 0.52 ac of jurisdictional wetlands would be disturbed along the railroad-spur corridor. Transmission-line corridors would permanently disturb about 690 ac of forest and affect approximately 1.15 ac of jurisdictional wetlands. Make-Up Pond C would impact about 821 ac of forest (of which about 545 ac are mixed hardwood and mixed hardwood-pine forest along London Creek and its tributaries), about 3.55 ac of jurisdictional wetlands, and about 884 linear ft of shoreline vegetation along jurisdictional streams. (See Section 4.3.1.) SMALL for operation impacts in the terrestrial environment. Minor impacts would be expected from cooling towers, transmission-line operation and transmission-line and water-pipeline corridor maintenance. Minor impacts would be expected to wetlands from drawdown of cooling-water reservoirs; minor impacts to wildlife from all other plant operations and maintenance activities. (See Section 5.3.1.)
Aquatic habitats and species	MODERATE. Preconstruction impacts in the aquatic environment include the permanent loss of 12.3 mi of lotic (flowing water) habitat and the alteration of 17.58 ac of open-water habitat within the reservoir footprint. Approximately 145 linear ft of tributaries would be permanently removed in association with installation of an enlarged replacement culvert under the existing railroad spur. An additional 9.37 ac of open-water habitat would be permanently altered (1.48 ac filled, 7.89 ac dredged) on the Lee Nuclear Station site. There would be minor and temporary impacts to aquatic resources from installing cooling-water intake and discharge systems, clearing and grading forested land, installing drainage and

Table 10-4. (contd)

Cost Category	Description of Cost
	erosion-control systems, building temporary roads and laydown yards, draining farm ponds, and adding impervious surfaces to the watershed. (See Section 4.3.2.) Temporary impacts include an additional 884 linear ft of tributaries associated with the building of Make-Up Pond C, 1345 linear ft of tributaries associated with the culvert replacement project under the existing railroad spur, and 94.68 ac of open-water habitat on the Lee Nuclear Station site. SMALL. Operation impacts in the aquatic environment include impingement and entrainment of aquatic organisms; minor physical, chemical, and thermal effects of blowdown discharge; minor impacts to aquatic biota and habitat from maintenance dredging; and limited impacts associated with maintenance of the transmission-line corridors. (See Section 5.3.2.)
Socioeconomic	The external costs of building and operating proposed Lee Nuclear Station Units 1 and 2 were discussed in detail in Sections 4.4 and 5.4. The review team determined these external costs would be SMALL, with the exception of a MODERATE impact on aesthetics and traffic during building activities near the site.
Environmental justice	SMALL. No environmental pathways were identified through which minority or low-income populations could experience a disproportionately high and adverse impact. (See Sections 4.5 and 5.5.)
Historic and cultural resources	MODERATE. The historic Service Family Cemetery would be relocated from Make-Up Pond C, which would result in irretrievable loss of the original historic setting of this resource. (See Sections 4.6 and 5.6.)
Air emissions	SMALL. Air emissions from diesel generators, auxiliary boilers and equipment, and vehicles would have a small impact on workers and local residents. Cooling-tower drift would deposit some salt on the surrounding vicinity, but at a level unlikely to result in any measurable impact on plants and vegetation. Cooling towers would produce atmospheric plume discharge. (See Sections 4.7 and 5.7.)

Table 10-4. (contd)

Cost Category	Description of Cost
Radioactive effluents and emissions	SMALL. Radioactive waste would be generated. The proposed Lee Nuclear Station would produce radioactive air emissions. Relatively small levels of radioactive liquid effluents would be introduced into the Broad River. (See Sections 4.9 and 5.9.)
Radioactive waste	SMALL.[(a)] Storage, treatment, and disposal of radioactive spent nuclear fuel. Commitment of geological resources for disposal of radioactive spent fuel. (See Section 6.1.6.)
Materials, energy, and uranium	SMALL. Irreversible and irretrievable commitments of materials and energy, including depletion of uranium.
Nonradiological health and wastes	SMALL. Nonradiological health impacts to the public and occupational workers would be SMALL; hazards would be monitored and controlled in accordance with regulatory limits. (See Sections 4.8 and 5.8.) SMALL. Creation of solid wastes, including small amounts of hazardous wastes. Permitted site stormwater releases to surface water. Minor, localized, and temporary air emissions from construction equipment and temporary stationary sources. (See Sections 4.10 and 5.10.)

(a) This conclusion is conditional on the results of the ongoing rulemaking to update the Waste Confidence Decision and Rule (see Section 6.1.6).

10.6.2.1 Internal Costs

The most substantial monetary cost associated with nuclear energy is the cost of capital. Nuclear power facilities typically have relatively high capital costs for building the facility, but very low fuel costs relative to alternative power-generation systems. Because of the large capital costs for nuclear power and the relatively long construction period before revenue is returned, servicing the capital costs of a nuclear power facility is the most important factor in determining the economic competitiveness of nuclear energy. Construction delays can add significantly to the cost of a plant. Because no new nuclear plants have been built in the United States in many years, empirical cost data are lacking and some uncertainty exists regarding the actual costs of construction.

Construction Costs

In evaluating the monetary costs related to building the proposed Lee Nuclear Station, Duke reviewed recently published literature, vendor information, and internally generated, site-specific, information. Construction-cost estimates are provided in Table 10-4. These estimates are based on a number of studies conducted by government agencies, universities, and other entities, and include a significant contingency to account for uncertainty. In its ER, Duke expressed the construction-cost estimate in terms of "overnight capital cost," which is a commonly used approach in the construction industry. "Overnight capital cost" is a term used to describe the monetary cost of constructing large capital projects such as a power plant, where costs are exclusive of interest and escalation, but include engineering, procurement, and construction costs, as well as owner's costs and contingencies. The owner's costs include such things as site work and preparation, cooling-water intake structures and cooling towers, import duties on components, insurance, spare parts, transmission interconnection, development costs, project management costs, owner's engineering, State and local permitting, legal fees, and staff-related training.

The review team reviewed two additional reports. One report published by The Keystone Center entitled *Nuclear Power Joint Fact-Finding* (The Keystone Center 2007) concluded that, based on alternative discount rates and construction times, overnight construction costs range between $3600 and $4200 per kW(e). The second study is a 2009 update to an MIT study (MIT 2009) that revised capital cost estimates to $4000 per kW(e).

In its ER, Duke estimated an overnight capital cost of $11 billion to build both units (Duke 2009c), which amounts to about $4900 per kW(e) in 2008 dollars, and is consistent with other studies. An additional $269 million would be required to connect the proposed Lee Nuclear Station Units 1 and 2 to the grid.

Operational Costs

Operational costs are frequently expressed as the levelized cost of electricity, which is the lowest price per kWh of producing electricity, including the cost needed to cover operating costs and annualized capital costs. Overnight capital costs account for 33 percent of the levelized cost, and interest costs on the overnight costs account for another 25 percent (University of Chicago 2004). Levelized cost estimates based on the MIT study (MIT 2009) range from $66 to $84 per MWh (6.6 cents to 8.4 cents per kWh). However, the Keystone Study estimates the levelized cost to range from 8.3 cents to 11.1 cents per kWh (Keystone Center 2007). Factors affecting the range include choices for discount rate, construction duration, facility lifespan, capacity factor, cost of debt and equity, the split between debt and equity financing, depreciation time, tax rates, and premium for uncertainty. Estimates include decommissioning but, due to the effect of discounting a cost that would occur as much as 40 years in the future, decommissioning costs have relatively little effect on the levelized cost. Duke reviewed several studies of operations costs and estimated costs to be approximately $17 to $37 per MWh (in 2007 dollars) (Duke 2009c). The review team did not find Duke's estimates to be unreasonable approximations, based on expected costs.

Fuel Costs

The cost of fuel is included in the calculation of levelized cost. Based on a recent World Nuclear Association study (WNA 2010), the review team estimates nuclear fuel costs to be less than half a cent (i.e., 0.45 cents) per kWh.

Waste Disposal

The back-end costs of nuclear power contribute a very small share of total cost, both because of the long lifetime of a nuclear reactor and the fact that provisions for waste-related costs can be accumulated over that time. However, it should be recognized that radioactive nuclear waste also poses unique disposal challenges for long-term waste management. While spent fuel and radioactive nuclear waste are being stored successfully in onsite facilities, the United States and other countries have yet to implement final disposition of spent fuel or high-level radioactive waste streams created at various stages of the nuclear fuel cycle.

Decommissioning

The NRC has requirements for licensees at 10 CFR 50.75 to provide reasonable assurance that funds would be available for the decommissioning process. Because of the effect of discounting a cost that would occur as much as 40 years in the future, decommissioning costs have relatively little impact on the levelized cost of electricity generated by a nuclear power facility. Decommissioning costs are about 9 to 15 percent of the initial capital cost of a nuclear power facility. However, when discounted, decommissioning costs contribute only a few percent to the investment cost and even less to the generation cost. In the United States, these costs account for 0.1 to 0.2 cents per kWh, which is no more than 5 percent of the cost of the electricity produced (WNA 2010). Duke's decommissioning costs are estimated to be about $516 million per unit in 2012 dollars (Duke 2013a).

10.6.2.2 External Costs

External costs are social and/or environmental effects caused by the proposed construction, preconstruction, and operation of and generation of power by the proposed Lee Nuclear Station Units 1 and 2.

Environmental and Social Costs

The impacts of building and operating proposed the Lee Nuclear Station have been identified and analyzed in Chapters 4 and 5, and a significance level of potential adverse impacts (i.e., SMALL, MODERATE, or LARGE) has been assigned. Such impacts cannot be universally monetized. Chapter 6 similarly addresses the environmental impacts from (1) the uranium fuel cycle and solid waste management, (2) the transportation of radioactive material, and (3) the decommissioning of proposed Lee Nuclear Station. A summary of project internal and external costs is shown in Table 10-4.

Unlike generation of electricity from coal and natural gas, normal operation of a nuclear power plant does not result in significant emissions of criteria air pollutants (e.g., oxides of nitrogen or sulfur dioxide), methyl mercury, or greenhouse gases associated with global warming and climate change. Combustion-based power plants are responsible for at least 70 percent of the sulfur dioxide, at least 21 percent of nitrogen oxides, and 51 percent of the mercury emissions from industrial sources in the United States (EPA 2009), and 40 percent of the nation's carbon dioxide emissions (DOE/EIA 2011). Eighty-two percent of the electric power industry's emissions are from coal-fired plants (DOE/EIA 2008). Chapter 9 of this EIS analyzes coal-fired and natural-gas-fired alternatives to building and operating proposed Lee Nuclear Station. Air emissions from these alternatives and from nuclear power are summarized in Chapters 4, 5, and 9.

Table 10-4 summarizes the external costs (i.e., environmental impacts) associated with the preconstruction, construction, and operation of the proposed Lee Nuclear Station Units 1 and 2. Table 4-7 summarizes the impacts from construction and preconstruction. Impacts to hydrology and water use, socioeconomics (with the exception of aesthetics and traffic during building activities near the site), environmental justice, air quality, and radiological and nonradiological health would all be SMALL. Impacts from the NRC action (i.e., construction as defined in 10 CFR 51.4, and the operation of the proposed new units) would also be SMALL. The impacts to land use, terrestrial and aquatic ecology, historic and cultural resources, and aesthetics (a physical socioeconomic impact) would be MODERATE for preconstruction activities; however, impacts to these resources from the NRC portion of the project would be SMALL. For traffic near the Lee Nuclear Station site (an infrastructure socioeconomic impact), the review team determined that the combined construction and preconstruction impact would be MODERATE, and the NRC portion of the project would also have a MODERATE impact on traffic in the vicinity of the proposed Lee Nuclear Station site.

10.6.3 Summary of Benefits and Costs

Duke's business decision to pursue building proposed Lee Nuclear Station is an economic decision based on private financial factors subject to regulation by North Carolina Utility Commission and Public Service Commission of South Carolina. The internal costs to build the proposed Lee Nuclear Station appear to be substantial; however, Duke's decision to pursue this expansion is an indication that the company has already concluded that the private, or internal, benefits of the proposed facility outweigh the internal costs. Although the identified societal benefits are not specifically monetized, the review team determined that the potential societal benefits of the proposed Lee Nuclear Station are substantial. In comparison, the external socioeconomic and environmental costs imposed on the region appear to be relatively small.

Table 10-3 and Table 10-4 include summaries of both benefits and costs (internal and external) of the proposed activities at the Lee Nuclear Station site. The tables include references to other sections of this EIS when more detailed analyses and impact assessments are available for specific topics. The external costs listed in Table 10-4 summarize environmental impacts to resources that could result from construction, preconstruction, and operation of the proposed Lee Nuclear Station. Because Table 10-4 includes costs for preconstruction activities and for NRC-authorized construction and operation, the costs presented for an individual resource may be greater than the costs solely for the NRC-authorized portion of the project.

On the basis of the assessments in this EIS, the building and operation of the proposed Lee Nuclear Station, with mitigation measures identified by the review team, would accrue benefits that most likely would outweigh the economic, environmental, and social costs. For the NRC-proposed action (i.e., NRC-authorized construction and operation), the accrued benefits would also outweigh the costs of construction, preconstruction, and operation of the proposed Lee Nuclear Station units.

10.7 NRC Staff Recommendation

The NRC staff's recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs should be issued.[a] The staff's evaluation of the safety and emergency preparedness aspects of the proposed action will be addressed in the staff's safety evaluation report that is anticipated to be published in as a NUREG document in 2015.

This recommendation is based on (1) the ER and the Make-Up Pond C supplement to the ER submitted by Duke (2009c, 2009b); (2) consultation with Federal, State, Tribal, and local agencies; (3) the review team's independent review; (4) the NRC staff's consideration of comments related to the environmental review that were received during the original public scoping process and the supplemental scoping process related to Make-Up Pond C, and comments on the draft EIS; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and in the EIS. In making its recommendation, the staff determined that none of the alternative sites is obviously superior to the Lee Nuclear Station site. The staff also determined that none of the energy or cooling-system alternatives assessed is obviously superior to the proposed cooling system and offsite supplemental cooling reservoir (i.e., Make-Up Pond C).

(a) As directed by the Commission in CLI-12-16 (NRC 2012h), NRC will not issue the COL prior to completion of the ongoing rulemaking to update the Waste Confidence Decision and Rule (see Section 6.1.6).

The NRC's determination is independent of the USACE's determination of whether the Lee Nuclear Station site is the least environmentally damaging practicable alternative pursuant to Clean Water Act Section 404(b)(1) Guidelines. The USACE will conclude its analysis of both offsite and onsite alternatives in its Record of Decision.

Appendix A

Contributors to the Environmental Impact Statement

Appendix A

Contributors to the Environmental Impact Statement

The overall responsibility for the preparation of this environmental impact statement was assigned to the Office of New Reactors, U.S. Nuclear Regulatory Commission (NRC). The statement was prepared by members of the Office of New Reactors with assistance from other NRC organizations, Pacific Northwest National Laboratory, the U.S. Army Corps of Engineers, and the Federal Energy Regulatory Commission.

Name	Affiliation	Function or Expertise
	NUCLEAR REGULATORY COMMISSION	
Patricia Vokoun	Office of New Reactors	Project Manager, Cultural Resources, Nonradiological Health and Nonradioactive Waste
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William Burton	Office of New Reactors	Environmental Projects Branch Chief
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Richard Raione[(a)]	Office of New Reactors	Environmental Projects Branch Chief
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John Cook	Office of New Reactors	Transportation
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Michael Masnik	Office of New Reactors	Hydrology, Aquatic Ecology

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Michele Hart	Office of New Reactors	Design Basis and Severe Accidents
Charles Hinson	Office of New Reactors	Health Physics
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Nancy Kuntzleman	Office of New Reactors	Terrestrial and Aquatic Ecology
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Michael Mazaika	Office of New Reactors	Meteorology, Air Quality
Mark McBride	Office of New Reactors	Groundwater Hydrology
Daniel Mussatti	Office of New Reactors	Socioeconomics, Environmental Justice, Need for Power, Benefit-Cost Balance
Donald Palmrose	Office of New Reactors	Health Physics, Accidents
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	US ARMY CORPS OF ENGINEERS	
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	PACIFIC NORTHWEST NATIONAL LABORATORY[b]	
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Nancy Kohn		Site Layout and Design
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Michelle Niemeyer		Land Use, Socioeconomics, Environmental Justice, Benefit-Cost Balance
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(a) Staff member is no longer with the Office of New Reactors, the Division of Siting and Environmental Reviews, or the NRC
(b) Pacific Northwest National Laboratory is operated by Battelle for the U.S. Department of Energy
(c) Staff member is affiliated with the Idaho National Laboratory, which is operated by Battelle for the U.S. Department of Energy

Appendix B

Organizations Contacted

Appendix B

Organizations Contacted

The following Federal, State, regional, Tribal, and local organizations were contacted during the course of the U.S. Nuclear Regulatory Commission staff's review of potential environmental impacts from the construction and operation of two new nuclear units (Units 1 and 2) at the William States Lee III Nuclear Station site in Cherokee County, South Carolina:

Advisory Council on Historic Preservation, Office of Federal Agency Programs, Washington, D.C.

Carolina Indian Heritage Association, Orangeburg, South Carolina

Catawba Indian Nation, Rock Hill, South Carolina

Cherokee County Library, Gaffney, South Carolina

Cherokee County, Gaffney, South Carolina

City of Gaffney, South Carolina

City of Gastonia, North Carolina

Eastern Band of Cherokee Indians, Cherokee, North Carolina

Eastern Shawnee Tribe of Oklahoma, Seneca, Missouri

Federal Energy Regulatory Commission, Division of Hydropower Administration & Compliance, Washington, D.C.

National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, Florida

North Carolina Department of Environment and Natural Resources, Raleigh, North Carolina

North Carolina Wildlife Resources Commission, Kernersville, North Carolina

Piedmont American Indian Association, Lower Eastern Cherokee Nation South Carolina, Gray Court, South Carolina

Pine Hill Indian Community, Orangeburg, South Carolina

Seminole Tribe of Florida, Clewiston, Florida

South Carolina Department of Archives and History, Columbia, South Carolina

South Carolina Department of Commerce, Columbia, South Carolina

South Carolina Department of Health and Environmental Control, Columbia, South Carolina

South Carolina Department of Natural Resources, Columbia, South Carolina

South Carolina State Historic Preservation Office, Columbia, South Carolina

Town of Blacksburg, South Carolina

United South and Eastern Federation of Tribes, Nashville, Tennessee

U.S. Army Corps of Engineers, Charleston District, Charleston, South Carolina

U.S. Environmental Protection Agency, Region 4, Atlanta, Georgia

U.S. Fish and Wildlife Service, Southeast Region, Atlanta, Georgia

U.S. Fish and Wildlife Service, South Carolina Ecological Services Field Office, Charleston, South Carolina

York Regional Chamber of Commerce, Rock Hill, South Carolina

Appendix C

NRC and USACE Environmental Review Correspondence

Appendix C

NRC and USACE Environmental Review Correspondence

This appendix contains a chronological listing of correspondence between the U.S. Nuclear Regulatory Commission (NRC) or the U.S. Army Corps of Engineers (USACE) and Duke Energy Carolinas, LLC (Duke). Also included is correspondence related to the environmental review of Duke's application for combined licenses (COLs) and an USACE Department of the Army permit at the William States Lee III Nuclear Station (Lee Nuclear Station) site in Cherokee County, South Carolina.

All documents, with the exception of those containing proprietary information, are available electronically from the Public Electronic Reading Room found on the Internet at the following web address: http://www.nrc.gov/reading-rm.html. From this site, the public can gain access to the NRC's Agencywide Document Access and Management System (ADAMS), which provides text and image files of the NRC's public documents. The ADAMS accession numbers for each document are included below.

December 12, 2007	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, regarding Duke Energy Carolinas, LLC, William States Lee III Nuclear Station – Project Number 742, Application for Combined License for William States Lee III Nuclear Station Units 1 and 2. (Accession No. ML073510494)
December 28, 2007	Press Release No. 07-172. Lee Application for New Reactors Available on NRC Website. (Accession No. ML073620508)
January 8, 2008	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from Joelle Starefos, NRC, Acknowledgement of Receipt of the Combined License Application for the William States Lee III Nuclear Station Units 1 and 2 and Associated *Federal Register* Notice. (Accession No. ML073620313)
January 28, 2008	*Federal Register* Notice of Receipt and Availability of Application for a Combined License for Duke Energy Carolinas (73 FR 6218). (Accession No. ML081840077)

February 11, 2008	Letter to Lana P. Gardner, Director, Cherokee County Library, from Linda Tello, NRC, Maintenance of Reference Materials Related to the Review of the William States Lee III Combined License Application at the Cherokee County Library. (Accession No. ML080250412)
February 25, 2008	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from Joelle Starefos, NRC, Acceptance Review for the William States Lee III Nuclear Station Units 1 and 2 Combined License Application. (Accession No. ML080510327)
February 28, 2008	Press Release No. 08-038. NRC Dockets Application for New Reactors at Lee Site in South Carolina. (Accession No. ML080590042)
February 29, 2008	*Federal Register* Notice of Acceptance for Docketing of an Application for a Combined License for William States Lee III Units 1 and 2 (73 FR 11156). (Accession No. ML081840051)
March 14, 2008	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Related to the Combined Operating License Application for William States Lee III Nuclear Station. (Accession No. ML080650521)
March 20, 2008	*Federal Register* Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process (73 FR 15009). (Accession No. ML080650528)
March 20, 2008	Letter to Lana P. Gardner, Director, Cherokee County Library, from Linda Tello, NRC, Maintenance of Reference Materials Related to the Review of the William States Lee III Combined License Application at the Cherokee County Library. (Accession No. ML080790619)
April 2, 2008	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from Joelle Starefos, NRC, William States Lee III Nuclear Station Units 1 and 2 Combined License Application Review Schedule. (Accession No. ML080920621)
April 9, 2008	E-mail to Ted Bowling, Duke, from Linda Tello, NRC, Table of [Site Audit] Information Needs and Requests for GIS Layers and Figures. (Accession No. ML081570627)

April 9, 2008	Letter to Don Klima, Director, Office of Federal Agency Programs, Advisory Council on Historic Preservation, from Richard Raione, NRC, Request for Participation in the Scoping Process for the William States Lee III Nuclear Station, Units 1 and 2 Combined Licenses Application Review. (Accession No. ML080840472)
April 9, 2008	Letter to Elizabeth Johnson, Deputy State Historic Preservation Officer, South Carolina Department of Archives and History, from Richard Raione, NRC, Request for Participation in the Scoping Process for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application Review. (Accession No. ML080840533)
April 9, 2008	Letter to Sam Hamilton, Regional Director, U.S. Fish and Wildlife Service, from Richard Raione, NRC, Request for Participation in the Environmental Scoping Process and a List of Protected Species within the Area Under Evaluation for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML080840475)
April 9, 2008	Letter to David Bernhart, Assistant Regional Administrator for Protected Species, National Marine Fisheries Service Southeast Regional Office, from Richard Raione, NRC, Request for Participation in the Scoping Process for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application Review. (Accession No. ML080850962)
April 9, 2008	Letter to Wenonah G. Haire, Tribal Historic Preservation Officer, Catawba Indian Nation, from Richard Raione, NRC, Request for Participation in the Scoping Process for the Environmental Review of the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML080840506)
April 9, 2008	Letter to Russell Townsend, Tribal Historic Preservation Officer, Eastern Band of Cherokee Indians, from Richard Raione, NRC, Request for Participation in the Scoping Process for the Environmental Review of the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML080840513)
April 9, 2008	Letter to Michelle Pounds, Chief Executive Officer, Carolina Indian Heritage Association, from Richard Raione, NRC, Request for Participation in the Scoping Process for the Environmental Review of the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML080840519)

April 9, 2008	Letter to Chief Glenna J. Wallace, Eastern Shawnee Tribe of Oklahoma, from Richard Raione, NRC, Request for Participation in the Scoping Process for the Environmental Review of the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML080840520)
April 9, 2008	Letter to Michael Cook, Executive Director, United South and Eastern Federation of Tribes, from Richard Raione, NRC, Request for Participation in the Scoping Process for the Environmental Review of the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML080840538)
April 9, 2008	Letter to Chief Gene Norris, Piedmont American Indian Association, Lower Eastern Cherokee Nation South Carolina, from Richard Raione, NRC, Request for Participation in the Scoping Process for the Environmental Review of the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML080840540)
April 9, 2008	Letter to Michelle Pounds, Representative, Pine Hill Indian Community, from Richard Raione, NRC, Request for Participation in the Scoping Process for the Environmental Review of the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML080840545)
April 11, 2008	Letter to Ron Linville, North Carolina Wildlife Resources Commission, from Richard Raione, NRC, Request for Participation in the Environmental Scoping Process for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML080880253)
April 17, 2008	Notice of Public Meeting To Discuss the Environmental Scoping Process for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application (TAC NO. RB5375). (Accession No. ML080980574)
April 28, 2008	*Federal Register* Notice of Hearing and Opportunity To Petition For Leave To Intervene (73 FR 22978). (Accession No. ML081130397)
April 28, 2008	Press Release No. 08-084. NRC Announces Opportunity to Participate in Hearing on New Reactor Application for Lee site. (Accession No. ML081190151)

May 5, 2008	Letter from David M. Bernhart, Assistant Regional Administrator for Protected Species, National Marine Fisheries Service, to Richard Raione, NRC, Endangered and Threatened Species and Critical Habitats under the Jurisdiction of the NOAA Fisheries Service for the William States Lee III Nuclear Station, Units 1 and 2. (Accession No. ML081400585)
May 12, 2008	E-mail from Rebekah Dobrasko, Review and Compliance Coordinator, South Carolina Department of Archives and History, State Historic Preservation Office, to Richard Raione and Linda Tello, NRC, SHPO Comments on Lee Nuclear Plant, Cherokee County, SC (Accession No. ML081510939)
May 13, 2008	Letter from Timothy N. Hall, Field Supervisor, U.S. Fish and Wildlife Service, to Richard Raione, NRC, William States Lee, III, Nuclear Station, Combined License Application County, Cherokee County, SC, FWS Log No. 42410-2008-SL-0407. (Accession No. ML081430228)
May 20, 2008	E-mail from Christopher Goudreau, Special Projects Coordinator, North Carolina Wildlife Resources Commission, to NRC, Duke Energy Carolina, LLC, William States Lee III Combined License Application; Notice of Intent To Prepare an Environmental Impact Statement and Conduct Scoping Process. (Accession No. ML081430390)
May 20, 2008	Letter from Robert D. Perry, Director, Office of Environmental Programs, South Carolina Department of Natural Resources, to Linda Tello, NRC, William States Lee III Nuclear Station – Project 0742. (Accession No. ML081430553)
May 21, 2008	Letter from Timothy N. Hall, Field Supervisor, U.S. Fish and Wildlife Service, to Richard Raione, NRC, William States Lee, III, Nuclear Station, Combined License Application, Cherokee County, SC, FWS Log No. 42410-2008-FA-0210. (Accession No. ML081540399)
May 28, 2008	Summary of Public Scoping Meeting Conducted Related to the Review of the William States Lee III, Units 1 and 2 Combined License Application. (Accession No. ML081420057)
May 29, 2008	Letter to Leigh Ann Turner, Gaffney City Hall, from Linda Tello, NRC, Thank You for Hosting the Discussion with the NRC in Advance of the Formal Environmental Scoping Public Meeting. (Accession No. ML081420812)

May 30, 2008	E-mail from Rebekah Dobrasko, Review and Compliance Coordinator, South Carolina Department of Archives and History, State Historic Preservation Office, to Linda Tello, NRC, Duke Energy's Lee Nuclear Plant, Cherokee County, SC. (Accession No. ML081510453)
June 4, 2008	Letter to Willard Steele, Tribal Historic Preservation Officer, Seminole Tribe of Florida, from Richard Raione, NRC, Request for Participation in the Scoping Process for the Environmental Review of the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML081430691)
June 9, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Information Needs. (Accession No. ML081640362)
June 11, 2008	Letter from Wenonah G. Haire, Tribal Historic Preservation Officer, Catawba Indian Nation, to NRC, Request for Participation in the Scoping Process for the Environmental Review of the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML081750079)
June 17, 2008	Correction to *Federal Register* Notice of Hearing and Opportunity To Petition For Leave To Intervene (73 FR 34348). (Accession No. ML081420185)
June 19, 2008	Letter to Julie Holling, National Heritage Program, South Carolina Department of Natural Resources, from Richard Raione, NRC, Request for Participation in the Scoping Process and List of Rare, Threatened, or Endangered Species for the Environmental Review for the William States Lee III Units 1 and 2 Combined License Application. (Accession No. ML081420749)
July 8, 2008	Letter from Julie Holling, Heritage Trust Program, South Carolina Department of Natural Resources, to Richard Raione, NRC, Request for Participation in the Scoping Process and List of Rare, Threatened, or Endangered Species for the Environmental Review for the William States Lee III Units 1 and 2 Combined License Application. (Accession No. ML081990424)
August 5, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Environmental Audit Information Needs. (Accession No. ML082200543)

August 18, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Information Needs Ltr # WLG2008.08-02. (Accession No. ML082340082)
August 21, 2008	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from Jessie Muir, NRC, Request for Additional Information Regarding the Environmental Review of the Combined License Application for William States Lee III Nuclear Station, Units 1 and 2. (Accession No. ML082200509)
September 11, 2008	Scoping Summary Report Related to the Environmental Scoping Process for the William States Lee III, Units 1 and 2 Combined License Application. (Accession No. ML082390635)
September 17, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.09-04. (Accession No. ML082630569)
September 17, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.09-05. (Accession No. ML082890448)
September 19, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Environmental Audit Information Needs, Letter No. WLG2008.08-08. (Accession No. ML082670803)
September 26, 2008	Summary of the Environmental Site Audit Related to the Review of the Combined Operating License Application for William States Lee III, Units 1 and 2. (Accession No. ML082210154)
September 26, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.09-11. (Accession No. ML082750078)
October 3, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.10-01. (Accession No. ML082890505)
October 10, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.10-04. (Accession No. ML082900340)

October 17, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.10-08. (Accession No. ML083010443)
October 17, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.10-07. (Accession No. ML083050603)
October 28, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.10-13. (Accession No. ML083080273)
November 4, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Duke Energy Carolinas 2008 Integrated Resource Plan Ltr # WLG2008.11-02. (Accession No. ML083110471)
November 12, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.11-14. (Accession No. ML083220435)
November 20, 2008	Letter from Tyler Howe, Tribal Historical Preservation Specialist, Eastern Band of Cherokee Indians, to NRC, Comments Related to the Review of the Combined License Application for Williams States Lee II, Units 1 and 2. (Accession No. ML083370297)
November 20, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.11-19. (Accession No. ML083659339)
November 20, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.11-20. (Accession No. ML083310541)
November 24, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.11-22. (Accession No. ML090500256)
November 24, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.11-24. (Accession No. ML083330445)

November 25, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.11-26. (Accession No. ML083360040)
November 25, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.11-28. (Accession No. ML083520465)
December 3, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.12-04. (Accession No. ML083440293)
December 9, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.12-10. (Accession No. ML083460113)
December 11, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.12-09. (Accession No. ML083510881)
December 11, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.12-12. (Accession No. ML083510884)
December 11, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.12-14. (Accession No. ML083520210)
December 12, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.12-11. (Accession No. ML083510883)
December 17, 2008	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2008.12-17. (Accession No. ML083520212)
January 21, 2009	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from Linda Tello, NRC, Request for Additional Information Regarding the Environmental Review of the Combined License Application for William States Lee III Nuclear Station, Units 1 and 2. (Accession No. ML083120589)

February 10, 2009	Letter from Lieutenant Colonel J. Richard Jordan III, U.S. Army, District Commander, USACE, Charleston District, to Linda Tello, NRC, Request to Serve as a Cooperating Agency in the Preparation of the EIS. (Accession No. ML090690283)
February 16, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.2-04. (Accession No. ML090490679)
February 16, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.2-05. (Accession No. ML090490676)
February 16, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.2-06. (Accession No. ML090490675)
February 19, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.2-08. (Accession No. ML090540808)
February 19, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.2-09. (Accession No. ML090540474)
February 19, 2009	Letter from Wenonah G. Haire, Tribal Preservation Officer, Catawba Indian Nation, to Linda Tello, NRC, Request for Additional Info Regarding the Environmental Review of the Combined License Application for William States Lee III Nuclear Station, Units 1 and 2. (Accession No. ML090840061)
February 26, 2009	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from Robert Schaaf, NRC, Change in Schedule of William States Lee III Nuclear Station, Units 1 and 2 Combined License Application Environmental Review. (Accession No. ML090420471)
March 6, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.03-03. (Accession No. ML090690536)

March 6, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.03-04. (Accession No. ML090690543)
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March 9, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.03-02. (Accession No. ML090700576)
March 18, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.03-08. (Accession No. ML090790309)
March 18, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.03-14. (Accession No. ML090790314)
March 18, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.03-15. (Accession No. ML090790312)
March 19, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.03-17. (Accession No. ML090830501)
March 30, 2009	Letter to Lieutenant Colonel J. Richard Jordan III, U.S. Army, District Commander, USACE, Charleston District, from Scott Flanders, NRC, Request to Cooperate with the NRC on the Environmental Impact Statement for the William States Lee III Nuclear Power Station, Units 1 and 2, Combined License Application. (Accession No. ML090700384)

March 30, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Revision 1 to the Environmental Report (Part 3) and Revision 2 to Withheld Information (Part 9) for William States Lee III Nuclear Station Units 1 and 2 Combined License Application. (Accession No. ML090990081)
April 14, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.04-01. (Accession No. ML091060497)
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April 28, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.04-05. (Accession No. ML091200383)
April 29, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.04-06. (Accession No. ML091200570)
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July 31, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.08-01. (Accession No. ML092170642)
July 31, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Supplemental Information Addressing Hydrology Associated with Off-Site Water Storage, Letter No. WLG2009.07-08. (Accession No. ML092230151)

August 14, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.08-06. (Accession No. ML092310276)
August 18, 2009	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from Robert Schaaf, NRC, Environmental Project Manager Change for the Combined Licenses Environmental Review for William States Lee III Nuclear Station, Units 1 and 2. (Accession No. ML092240458)
September 4, 2009	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from Robert Schaaf, NRC, Update on the William States Lee III Nuclear Station Units 1 and 2 Combined License Application Environmental Review. (Accession No. ML092170267)
September 14, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.09-03. (Accession No. ML092580475)
September 14, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.09-04. (Accession No. ML092580474)
September 14, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, 2009 Integrated Resource Plan, Letter No. WLG2009.09-02. (Accession No. ML092590318)
September 23, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.09-07. (Accession No. ML092710039)
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September 24, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.09-05. (Accession No. ML092810255)
September 24, 2009	Supplement to Revision 1 of the William States Lee III Nuclear Station COL Application, Part 3; Construction and Operation of Make-Up Pond C. (Accession No. ML092810257)
October 16, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.10-01. (Accession No. ML092930116)
November 2, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2009.11-01. (Accession No. ML093130451)
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December 11, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, to NRC, Response to Request for Additional Information, Letter No. WLG2009.12-05. (Accession No. ML093490247)
December 11, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Updated Information Addressing Hydrology Associated with Off-Site Water Storage, Letter No. WLG2009.12-03. (Accession No. ML093490765)
December 11, 2009	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, to NRC, Response to Request for Additional Information, Letter No. WLG2009.12-07. (Accession No. ML093491111)

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January 8, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.01-01. (Accession No. ML100120287)
March 31, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Editorial Text Changes to the Environmental Report, Letter No. WLG2010.03-09. (Accession No. ML100920024)
April 14, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, 2009 Integrated Resource Plan, Revision 1, Letter No. WLG2010.04-03. (Accession No. ML101090314)
May 18, 2010	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from Scott Flanders, NRC, Notice of Intent to Conduct Supplemental Scoping Related to the Combined License Application for William States Lee III Nuclear Station. (Accession No. ML093420654)
May 24, 2010	*Federal Register* Notice of Intent To Conduct a Supplemental Scoping Process for the Supplement to the Environmental Report (75 FR 28822). (Accession No. ML093430226)
May 24, 2010	Letter to Caroline Dover Wilson, South Carolina Department of Archives and History, State Historic Preservation Office, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML093480445)
May 24, 2010	Letter to Don Klima, Director, Office of Federal Agency Programs, Advisory Council on Historic Preservation, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML093560024)

May 24, 2010	Letter to Robert D. Perry, Director, Office of Environmental Programs, South Carolina Department of Natural Resources, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application (DNR Project 0742). (Accession No. ML093570175)
May 24, 2010	Letter to Jay B. Herrington, Field Supervisor, U.S. Fish and Wildlife Service, South East Region, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML093580019)
May 24, 2010	Letter to Ron Linville, North Carolina Wildlife Resources Commission, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101190491)
May 24, 2010	Letter to Susan Turner, Regional Director, South Carolina Department of Health and Environmental Control, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101190500)
May 24, 2010	Letter to Ramona McConney, National Environmental Policy Act Program Office, U.S. Environmental Protection Agency, Region 4, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101200120)
May 24, 2010	Letter to Wenonah G. Haire, Tribal Historic Preservation Officer, Catawba Indian Nation, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101200150)

May 24, 2010	Letter to Willard Steele, Tribal Historic Preservation Officer, Seminole Tribe of Florida, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101200368)
May 24, 2010	Letter to Russell Townsend, Tribal Historic Preservation Officer, Eastern Band of Cherokee Indians, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101200371)
May 24, 2010	Letter to Chief Glenna J. Wallace, Eastern Shawnee Tribe of Oklahoma, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101200375)
May 24, 2010	Letter to Michelle Pounds, Chief Executive Officer, Carolina Indian Heritage Association, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101200416)
May 24, 2010	Letter to Michael Cook, Executive Director, United South and Eastern Federation of Tribes, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101200435)
May 24, 2010	Letter to Chief Gene Norris, Piedmont American Indian Association, Lower Eastern Cherokee Nation of South Carolina, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101200443)

May 24, 2010	Letter to Michelle Pounds, Representative, Pine Hill Indian Community, from Robert Schaaf, NRC, Request for Participation in a Supplemental Scoping Process Regarding the Addition of a Third Cooling Water Reservoir for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101200452)
May 25, 2010	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from Sarah Lopas, NRC, NRC Web Address Correction to the May 18, 2010, *Federal Register* Notice for William States Lee III Nuclear Station, Units 1 and 2 Supplemental Scoping Process. (Accession No. ML101440498)
May 26, 2010	Press Release No. 10-094. NRC Seeking Additional Environmental Scoping Comments Regarding Lee New Reactor Application, Meeting June 17. (Accession No. ML101460482)
May 27, 2010	Forthcoming Meeting to Discuss the Scoping Process for the Supplemental Environmental Report Regarding Make-Up Pond C for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101450144)
May 27, 2010	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from Robert Schaaf, NRC, Environmental Project Manager Change for the Combined License Environmental Review for William States Lee III Nuclear Station, Units 1 and 2. (Accession No. ML101330578)
June 1, 2010	*Federal Register* Notice of Intent; Correction (75 FR 30451). (Accession No. ML101450180)
June 11, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information (ER RAI 119, Supplement E), Letter No. WLG2010.06.02. (Accession No. ML101650706)
June 11, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Corrected Information Addressing Existing Land Use in York County, South Carolina, Letter No. WLG2010.06-03. (Accession No. ML101650529)

June 21, 2010	E-mail from Caroline Dover Wilson, South Carolina Dept. of Archives and History, State Historic Preservation Office, to NRC, Lee Nuclear Station, Pond C, Cherokee County, South Carolina. (Accession No. ML101720651)
June 22, 2010	Letter to Bryan J. Dolan, Vice President Nuclear Plant Development, Duke, from Sarah Lopas, NRC, Request for Additional Information Regarding the Supplement to the Environmental Report for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML101370398)
June 23, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.06-05. (Accession No. ML101800213)
June 25, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.06-06. (Accession No. ML101810147)
July 1, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.07-01. (Accession No. ML101880072)
July 2, 2010	Summary of Supplemental Environmental Scoping Meeting Conducted Related to the Combined License Application Review of the William States Lee III Nuclear Station, Units 1 and 2. (Accession No. ML101800406)
July 7, 2010	Summary of Teleconference Held on June 15, 2010, between NRC and Duke Concerning Request For Additional Information Regarding Make-Up Pond C for the William States Lee III Nuclear Station, Units 1 and 2. (Accession No. ML101870564)
July 9, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.07-03. (Accession No. ML101950211)
July 9, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Conforming Changes to Environmental Report Based on Supplemental Response to Request for Additional Information, Letter No. WLG2010.07-04. (Accession No. ML101940026)

July 16, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.07-06. (Accession No. ML102100214)
July 16, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.07-07. (Accession No. ML102020479)
July 22, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.07-08. (Accession No. ML102070357)
July 22, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.07-09. (Accession No. ML102090223)
July 22, 2010	Letter from Wenonah G. Haire, Tribal Historic Preservation Officer, Catawba Indian Nation, to Scott Flanders, NRC, THPO# 2010-229-1, Project Description: Notice of Intent to Conduct Supplemental Scoping Related to the Combined License Application for William States III Nuclear Station. (Accession No. ML102110494)
July 27, 2010	Letter from Vivianne Vejdani, Nuclear Projects Coordinator, South Carolina Department of Natural Resources, to NRC, William States Lee III Nuclear Station Combined License Application Notice of Intent to Conduct a Supplemental Scoping Process for the Supplement to the Environmental Report. (Accession No. ML102160393)
July 30, 2010	E-mail to Robert Wylie, Duke, from Sarah Lopas, NRC, Pond C Audit Info Needs. (Accession No. ML102110501)
September 7, 2010	Letter from Bryan J. Dolan, Vice President Nuclear Plant Development, Duke, to NRC, Information Omitted from Response to Environmental Report RAI 192, Letter No. WLG2010.09-01. (Accession No. ML102530391)
September 14, 2010	Letter to Bryan J. Dolan, Vice President Nuclear Plant Development, Duke, from Sarah Lopas, NRC, Follow-Up Requests for Additional Information Regarding the Supplement to the Environmental Report for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML102371163)

September 28, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.09-08. (Accession No. ML102740485)
September 30, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.09-10. (Accession No. ML102780268)
October 6, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.10-01. (Accession No. ML102810637)
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October 14, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, 2010 Integrated Resource Plan, Letter No. WLG2010.10-07. (Accession No. ML102980231)
October 29, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.10-09. (Accession No. ML103070311)
November 4, 2010	Notice of Forthcoming Public Teleconference with Duke Energy Carolinas, LLC, to Discuss a Request for Additional Information Response for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application Environmental Review. (Accession No. ML103070537)
November 12, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2010.11-02. (Accession No. ML103210413)

November 19, 2010	Letter to Sandra J. Threatt, Manager, Nuclear Response and Emergency Environmental Surveillance, Bureau of Land and Waste Management, South Carolina Department of Health and Environmental Control, from Brian Hughes, NRC, Response to e-mail from Ms. Threatt dated October 25, 2010, regarding environmental monitoring around the proposed William States Lee III Nuclear Station, Units 1 and 2. (Accession No. ML103150012)
December 17, 2010	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Responses to Request for Additional Information, Letter No. WLG2010.12-01. (Accession No. ML103550032)
December 21, 2010	Site Audit Summary of William States Lee III Nuclear Station, Units 1 and 2, Supplemental Environmental Report Regarding Make-Up Pond C, and Alternative Sites Tour. (Accession No. ML102640559)
December 22, 2010	Summary Report for the Supplemental Environmental Scoping Process for the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML103220015)
January 11, 2011	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from David Matthews, NRC, William States Lee III Nuclear Station, Units 1 and 2 Combined License Application – Revised Review Schedule. (Accession No. ML103370325)
January 25, 2011	Summary of Public Teleconference Held on November 17, 2010, Between the U.S. Nuclear Regulatory Commission and Duke Energy Carolinas, LLC, Regarding the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application Environmental Review. (Accession No. ML103630488)
January 26, 2011	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Responses to Request for Additional Information, Letter No. WLG2011.01-03. (Accession No. ML110310017)
February 4, 2011	Letter to Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, from Sarah Lopas, NRC, Request for Additional Information Regarding the Environmental Review of the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML110140852)

February 10, 2011	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information (ER RAI 135), Letter No. WLG2011.02-03. (Accession No. ML110450507)
March 7, 2011	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2011.03-01. (Accession No. ML110700592)
March 14, 2011	Letter to Dr. Wenonah G. Haire, Tribal Historic Preservation Officer, Catawba Indian Nation, from Allen Fetter, NRC, Cultural Resources Information Related to the William States Lee Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML103000023)
March 17, 2011	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Response to Request for Additional Information (ER RAI 135), Letter No. WLG2011.03-02. (Accession No. ML110800094)
March 17, 2011	Letter from Bryan J. Dolan, Vice President, Nuclear Plant Development, Duke, to NRC, Supplemental Response to Requests for Additional Information (ER RAIs 70 and 189), Letter No. WLG2011.03-08. (Accession No. ML110830912)
May 4, 2011	Letter from Ronald A. Jones, Senior Vice President, Nuclear Plant Development, Duke, to NRC, Supplemental Response to Request for Additional Information (ER RAI 23), Letter No. WLG2011.05-01. (Accession No. ML11129A054)
May 20, 2011	E-mail to Robert Wylie, Duke, from Sarah Lopas, NRC, Lee Alternatives Audit Information Needs. (Accession No. ML111400413)
May 25, 2011	Letter to Julie Holling, South Carolina Department of Natural Resources, Heritage Trust Program, from James A. Becker, Pacific Northwest National Laboratory, Request for Federally Listed Species, State Ranked Species, and Community Element Occurrences for the Environmental Review of the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML111470774)

May 25, 2011	Letter to Harry LeGrand, North Carolina Department of Environment and Natural Resources, Heritage Trust Program, from James A. Becker, Pacific Northwest National Laboratory, Request for Federally Listed Species, State Ranked Species, and Community Element Occurrences for the Environmental Review of the William States Lee III Nuclear Station Units 1 and 2 Combined License Application. (Accession No. ML114470794)
June 7, 2011	Summary of teleconference held on May 3, 2011, between NRC and Duke, Regarding the William States Lee Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML111400028)
June 8, 2011	E-mail from Julie Holling, South Carolina Department of Natural Resources, Regarding Request for Federally Listed Species, State Ranked Species, and Community Element Occurrences for the Lee Nuclear Station and Alternative Sites. (Accession No. ML111741378)
June 16, 2011	Letter from Ronald A. Jones, Senior Vice President, Nuclear Development, Duke, to NRC, Responses to Request for Additional Information, Letter No. WLG2011.06-03. (Accession No. ML11172A288)
June 16, 2011	Letter from Ronald A. Jones, Senior Vice President, Nuclear Development, Duke, to NRC, Supplemental Response to Request for Additional Information (ER RAI 63), Letter No. WLG2011.06-05. (Accession No. ML11172A315)
June 23, 2011	E-mail from John Finnegan, North Carolina Department of Environment and Natural Resources, Regarding Request for Federally Listed Species, State Ranked Species, and Community Element Occurrences for Perkins Alternative Site. (Accession No. ML111741383)
June 23, 2011	Letter from Ronald A. Jones, Senior Vice President, Nuclear Development, Duke, to NRC, Responses to Request for Additional Information, Letter No. WLG2011.06-04. (Accession No. ML11179A079)
July 5, 2011	Letter from Ronald A. Jones, Senior Vice President, Nuclear Development, Duke, to NRC, Responses to Request for Additional Information, Letter No. WLG2011.07-02. (Accession No. ML11195A165)

July 8, 2011	Letter from Ronald A. Jones, Senior Vice President, Nuclear Development, Duke, to NRC, Responses to Request for Additional Information, Letter No. WLG2011.07-04. (Accession No. ML1119A0082)
August 4, 2011	Letter from Ronald A. Jones, Senior Vice President, Nuclear Development, Duke, to NRC, Response to Request for Additional Information, Letter No. WLG2011.08-01. (Accession No. ML112220296)
September 13, 2011	Letter from Tyler B. Howe, Tribal Historic Preservation Specialist, Eastern Band of Cherokee Indians, to NRC, Comments regarding proposed Duke Energy William States Lee III Nuclear Station, Cherokee and Union Counties, South Carolina. (Accession No. ML112570445)
September 15, 2011	Letter from Ronald A. Jones, Senior Vice President, Nuclear Development, Duke, to NRC, 2011 Integrated Resource Plan, Lt# WLG2011.09-04. (Accession No. ML11262A205)
October 3, 2011	Letter to Ronald A. Jones, Senior Vice President, Nuclear Development, from David B. Matthews, NRC, William States Lee III Nuclear Station, Units 1 and 2 Combined License Application Review Schedule Revision. (Accession No. ML11224A216)
October 4, 2011	E-mail to Thomas J. LoVullo, Chief, Aquatic Resources Branch, Division of Hydropower Administration and Compliance, U.S. Federal Energy Regulatory Commission, from Sarah Lopas, NRC, Participating Agency Invitation for the Lee Nuclear Station Environmental Review. (Accession No. ML112790295)
October 5, 2011	Letter from Thomas J. LoVullo, Chief, Aquatic Resources Branch, Division of Hydropower Administration and Compliance, U.S. Federal Energy Regulatory Commission, to Allen H. Fetter, NRC, Project No. 2331—South Carolina, Ninety-Nine Islands Project, Duke Energy. (Accession No. ML112790296)
October 18, 2011	Summary of William States Lee III Nuclear Station, Units 1 and 2, Cooling System and Energy Alternatives Audit. (Accession No. ML112760826)

December 12, 2011	Letter from Lieutenant Colonel Edward P. Chamberlayne, Commander and District Engineer, U.S. Army, to William Burton, NRC, Draft Environmental Impact Statement for Combined Licenses for William States Lee III Nuclear Station Units 1 and 2. (Accession No. ML12108A192)
December 12, 2011	Letter to Ronald A. Jones, Senior Vice President, Nuclear Development, from William F. Burton, NRC, Notice of Availability of the Draft Environmental Impact Statement for William States Lee III Nuclear Station Units 1 and 2 Combined Licenses Application Review. (Accession No. ML112940260)
December 12, 2011	*Federal Register* Notice of Availability of the Draft Environmental Impact Statement for Combined Licenses for Units 1 and 2 at the Williams States Lee III Nuclear Station Site (76 FR 79228). (Accession No. ML112940305)
December 12, 2011	Letter to U.S. Environmental Protection Agency, Office of Federal Activities, NEPA Compliance Division, from William F. Burton, NRC, Submittal of the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined Licenses Application Review. (Accession No. ML112940233)
December 12, 2011	Letter to Ramona McConney, NEPA Program Office, U.S. Environmental Protection Agency, from William F. Burton, NRC, Request for Comments on the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined License Application Review. (Accession No. ML11319A023)
December 12, 2011	Letter to Reid Nelson, Director, Office of Federal Agency Programs, Advisory Council on Historic Preservation, from William F. Burton, NRC, Request for Comments on the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined License Application Review. (Accession No. ML11332A003)
December 12, 2011	Letter to Jay B. Herrington, U.S. Fish and Wildlife Service, from William F. Burton, NRC, Request for Comments on the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined License Application Review. (Accession No. ML11332A001)

December 12, 2011	Letter to Russell Townsend, Tribal Historic Preservation Officer, Eastern Band of the Cherokee Indians, from William F. Burton, NRC, Notification of the Issuance of the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined Licenses Application Review. (Accession No. ML11332A006)
December 12, 2011	Letter to Wenonah G. Haire, Tribal Historic Preservation Officer, Catawba Indian Nation, from William F. Burton, NRC, Notification of the Issuance of the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined Licenses Application Review. (Accession No. ML11332A005)
December 12, 2011	Letter to Michael Cook, Executive Director, United South and Eastern Federation of Tribes, from William F. Burton, NRC, Notification of the Issuance of the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined Licenses Application Review. (Accession No. ML11332A061)
December 12, 2011	Letter to Michelle Pounds, Chief Executive Office, Carolina Indian Heritage Association, from William F. Burton, NRC, Notification of the Issuance of the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined Licenses Application Review. (Accession No. ML11332A004)
December 12, 2011	Letter to Willard Steele, Tribal Historic Preservation Officer, Seminole Tribe of Florida, from William F. Burton, NRC, Notification of the Issuance of the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined Licenses Application Review. (Accession No. ML11332A104)
December 12, 2011	Letter to Chief Glenna J. Wallace, Eastern Shawnee Tribe of Oklahoma, from William F. Burton, NRC, Notification of the Issuance of the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined Licenses Application Review. (Accession No. ML11332A007)
December 12, 2011	Letter to Chief Gene Norris, Piedmont American Indian Association, from William F. Burton, NRC, Notification of the Issuance of the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined Licenses Application Review. (Accession No. ML11332A008)

December 12, 2011	Letter to Michelle Pounds, Representative, Pine Hill Indian Community, from William F. Burton, NRC, Notification of the Issuance of the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined Licenses Application Review. (Accession No. ML11332A011)
December 12, 2011	Letter to Rebekah Dobrasko, State Historic Preservation Office, South Carolina Department of Archives and History, from William F. Burton, Notification of the Issues of the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 (Accession No. ML11332A002)
December 12, 2011	Letter to Robert D. Perry, Director, Office of Environmental Programs, South Carolina Department of Natural Resources, from William F. Burton, NRC, Request for Comments on the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined License Application Review. (Accession No. ML11314A229)
December 12, 2011	Letter to Susan Turner, Regional Director, South Carolina Department of Health and Environmental Control, from William F. Burton, NRC, Request for Comments on the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined License Application Review. (Accession No. ML11313A167)
December 12, 2011	Letter to Christopher Goudreau, North Carolina Wildlife Resources Commission, Division of Inland Fisheries, from William F. Burton, NRC, Request for Comments on the Draft Environmental Impact Statement for the William States Lee III Nuclear Station Units 1 and 2 Combined License Application Review. (Accession No. ML11319A017)
December 13, 2011	Press Release No. 11-220. NRC Seeks Public Input on Draft Environmental Impact Statement for Lee Nuclear Station New Reactors; Meetings Scheduled Jan. 19. (Accession No. ML113470656)
December 15, 2011	Notice of Forthcoming Public Meeting to Discuss the Draft Environmental Impact Statement for the Combined Licenses for the William States Lee III Nuclear Station, Units 1 and 2. (Accession No. ML113400335)

January 20, 2012	Letter from Rebekah Dobrasko, Supervisor of Compliance, Tax Incentives, and Survey, State Historic Preservation Office, to Cindy Bladey, NRC, William States Lee III Nuclear Station Units 1 and 2 Draft Environmental Impact Statement, Cherokee County, South Carolina, SHPO Project No. 06-RD0163. (Accession No. ML12048A671)
February 2, 2012	Letter to Larry Lawrence, Restoration Church International, from Sarah Lopas, NRC, Letter of Appreciation for Use of Restoration Church International for the William States Lee III Nuclear Station Units 1 and 2 Draft Environmental Impact Statement Public Meetings. (Accession No. ML12032A115)
February 2, 2012	Letter to James Taylor, City Administrator, from Sarah Lopas, NRC, Letter of Appreciation for Use of Gaffney City Hall for the William States Lee III Nuclear Station Units 1 and 2 Draft Environmental Impact Statement Government-to-Government Meeting. (Accession No. ML12032A180)
February 8, 2012	Letter to Sheriff Steve Mueller and Major Tim Hartman, Cherokee County Sheriff's Office, from Patrick Madden, NRC, Letter of Appreciation for Protective Services for the William States Lee III Nuclear Station Units 1 and 2 Draft Environmental Impact Statement Public Meetings. (Accession No. ML12032A104)
February 13, 2012	Summary of the Public Meetings for the Draft Environmental Impact Statement to Support Review of the William States Lee III Nuclear Station Units 1 and 2 Combined Licenses Application. (Accession No. ML12032A228)
February 23, 2012	Letter from Jodi Barnes, South Carolina Department of Archives and History, State Historic Preservation Office to Cindy Bladey, NRC, Proposed Transportation Improvements, Lee Nuclear Station, Cherokee County, South Carolina, SHPO Project No. 06RD163. (Accession No. ML12093A006)
February 29, 2012	Letter from Joyce Stanley, Regional Environmental Protection Assistant for Gregory Hogue, Regional Environmental Officer, United States Department of the Interior, Office of the Secretary, Office of Environmental Policy and Compliance, to Cindy Bladey, NRC, Comments on the Combined Licenses for William States Lee III Nuclear Station Units 1 and 2. (Accession No. ML12083A060)

March 1, 2012	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy, to Chief, Rulemaking and Directives Branch, NRC, Comments on the Draft Environmental Impact Statement for Combined Licenses (COLs) for William States Lee III Nuclear Station Units 1 and 2, Ltr# WLG2012.03-01. (Accession No. ML12067A037)
March 5, 2012	Letter from Jay B. Herrington, Field Supervisor, Fish and Wildlife Service, to Chief, Rulemaking and Directives Branch, NRC, Comments on the Draft Environmental Impact Statement for Combined Licenses for William States Lee III Nuclear Station Units 1 and 2, ER11/1166, Cherokee County, South Carolina, FWS Log No. 2012-CPA-0041. (Accession No. ML12083A064)
March 6, 2012	Letter from Jay B Herrington, Field Supervisor, U.S. Fish and Wildllife Service, to Lt. Col. Edward P Chamberlayne, U.S. Army Corps of Engineers, Charleston District Commander, FWS Log No. 2012-CPA-0036. (Accession No. ML13317B884)
March 6, 2012	Letter from Virginia M Fay, Assistant Regional Director, Habitat Conservation Division, National Marine Fisheries Service, to Lt. Col. Edward P Chamberlayne, U.S. Army Corps of Engineers, Charleston District Commander. (Accession No. ML13317A347)
March 6, 2012	Letter from Bob Perry, Director Office of Environmental Resources, South Carolina Department of Natural Resources, to Dr. Richard Darden, U.S. Army Corps of Engineers, and Ms. Alicia Rowe, South Carolina Department of Health and Environmental Control. (Accession No. ML12083A059)
March 6, 2012	Letter from Ben Gregg, Executive Director, South Carolina Wildlife Federation, to Nuclear Regulatory Commission, Comments on NUREG-2111, Docket ID NRC-2008-0170. (Accession No. ML12068A364)
March 6, 2012	Letter from Robert D. Perry, Director, Office of Environmental Programs, South Carolina Department of Natural Resources, to Chief, Rulemaking, Directives, and Editing Branch, NRC-2008-0170, Comments on Draft Environmental Impact Statement for Combined Licenses for Units 1 and 2 at the William States Lee III Nuclear Station Site, Cherokee County, South Carolina. (Accession No. ML12083A059)

March 16, 2012	Letter from Heinz J. Mueller, Chief, NEPA Program Office, Office of Policy and Management, U.S. Environmental Protection Agency, Region 4, to Chief, Rulemaking and Directives Branch, EPA Review and Comments, Draft Environmental Impact Statement (DEIS) for the William States Lee III Nuclear Station Units 1 and 2, Combined Licenses (COLs) Application, Constructing and Operating Two New Nuclear Units at the Lee Nuclear Station Site, NUREG-2111, CEQ No. 20110423. (Accession No. ML120790121)
March 29, 2012	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy, to NRC, Supplemental Response to Request for Additional Information, Ltr# WLG2012.03-09. (Accession No. ML12093A006)
March 29, 2012	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy, to NRC, Supplemental Information to the Environmental Report (Revision 1), Ltr# WLG2012.03-10. (Accession No. ML12093A005)
March 29, 2012	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy, to NRC, Supplemental Response to Request for Additional Information, Ltr# WLG2012.03-11. (Accession No. ML12096A077)
March 29, 2012	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy, to NRC, Supplemental Response to Request for Additional Information, Ltr# WLG2012.03-12. (Accession No. ML12093A197)
April 10, 2012	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy, to NRC, Supplemental Response to Request for Additional Information, Ltr# WLG2012.04-01. (Accession No. ML12143A293)
April 30, 2012	Letter from Christopher M. Fallon, Vice President, Nuclear Development (Acting), Duke Energy, to NRC, Supplemental Response to Request for Additional Information, Ltr# WLG2012.04-05. (Accession No. ML12123A715)

April 30, 2012	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy, to NRC, Supplemental Response to Request for Additional Information, Ltr# WLG2012.04-06. (Accession No. ML12123A712)
April 30, 2012	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy, to NRC, Supplemental Response to Request for Additional Information, Ltr# WLG2012.04-08. (Accession No. ML12123A714)
May 18, 2012	Summary of William States Lee III Nuclear Station, Units 1 and 2 Section 404 Joint Permit Application Mitigation Sites Visit. (Accession No. ML12132A218)
May 21, 2012	E-mail from Eric Hawk, Southeast Region ESA Section 7 Coordinator, National Marine Fisheries Service, to Sarah Lopas, NRC, Lee Nuclear Station consultation requirements. (Accession No. ML12171A581)
June 13, 2012	Letter from Jay B. Herrington, Field Supervisor, U.S. Fish and Wildlife Service, South East Region, to Sarah Lopas, NRC, Comments on the Draft Environmental Impact Statement for Combined Licenses for William States Lee III Nuclear Station Units 1 and 2, ER 11/1166, Cherokee County, South Carolina, FWS Log No. 2012-CPA-041. (Accession No. ML12221A475**)**
June 21, 2012	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy, to NRC, Supplemental Response to Request for Additional Information, Ltr# WLG2012.06-08. (Accession No. ML12178A450)
August 8, 2012	E-mail to Robert Wylie, Duke Energy, from Sarah Lopas, NRC, Ponds A and B Drawdown. (Accession No. ML12280A014)
August 14, 2012	Letter to David Bernhart, Assistant Regional Administrator for Protected Species, National Marine Fisheries Service Southeast Regional Office, from William F. Burton, NRC, Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, and Fish and Wildlife Coordination Act Consultation Close out for the William States Lee III Nuclear Station, Units 1 and 2 Combined Licenses Application Environmental Review. (Accession No. ML12173A383)

September 19, 2012	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy, to NRC, Supplemental Information Request, Ltr# WLG2012.09-01. (Accession No. ML12265A066)
October 3, 2012	Letter from Robert Kitchen, Licensing Manager, Nuclear Development, to NRC, 2012 Integrated Resource Plan, Ltr# WLG2012.10-01. (Accession No. ML12279A105)
October 22, 2012	Letter from Richard Darden, USACE, to Wenonah G. Haire, Tribal Historic Preservation Officer, Catawba Indian Nation, Re: Cultural Resources Management Plan and Memorandum of Agreement (MOA). (Accession No. ML13219A882)
November 13, 2012	Email from John Finnegan, Conservation Information Manager, North Carolina Natural Heritage Program, Office of Conservation, Planning and Community Affairs to James M. Becker, PNNL, Re: Lee Nuclear Request of 05-25-11, Transmitting North Carolina Department of Environment and Natural Resources' Updated Summary of North Carolina Species of Concern Records within 15 Miles of the Perkins Site. (Accession Nos. ML13213A439, ML13213A450)
November 20, 2012	Email from Julie Holling, South Carolina Department of Natural Resources, to Jim Becker, Pacific Northwest National Laboratory, Transmitting South Carolina Department of Natural Resources' Updated Summary of South Carolina Species of Concern records within 15 miles of the Lee, Kewoee, and Middleton Site. (Accession Nos. ML13214A349, ML13214A350)
December 3, 2012	Letter from Robert Wylie, Environmental Project Manager, Duke Energy, to Richard Darden, U.S. Army Corps of Engineers, Subject: William States Lee III Nuclear Station, Cherokee County, South Carolina, 404 Application and Jurisdicational Determination. (Accession No. ML13213A412)
December 20, 2012	Letter from Bryan Dolan, Duke Energy, Vice President, Nuclear Development, Duke Energy, to NRC, Supplemental Information Related to Design Changes to the Lee Units 1 and 2 Physical Locations, Ltr# WLG2012.12-02. (Accession No. ML12361A059)

January 10, 2013	E-mail from Richard Darden, USACE, to Robert Wylie, Duke Energy, Rebekah Dobrasko, SCSHPO, Wenonah Haire, Catawba Indian Nation, Patricia Vokoun, NRC, Laura M SAC, Lee Nuclear Station – Cultural Resource Management Plan. (Accession No. ML13213A408)
January 10, 2013	Email from Richard Darden, Regulatory Division, USACE to Patricia Vokoun, NRC, FW: Proposed drawdown of Ponds A and B (UNCLASSIFIED). Forwarding email from Vivianne Vejdani, Environmental Coordinator, Wildlife and Freshwater Fisheries Division, South Carolina Department of Natural Resources. (Accession No. ML13219A947)
January 11, 2013	Letter from Richard L. Darden, Project Manager, USACE, to Robert Wylie, Duke Energy Carolinas, Re: SAC2009-122-SJR. Enclosures – Approved Jurisdictional Determination Forms. (Accession No. ML13221A019, ML13221A024)
March 13, 2013	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy to NRC, Duke Energy Carolinas, LLC, William States Lee III Nuclear Station – Docket Nos. 52-018 and 52-019, AP1000 Combined License Application for the William States Lee III Nuclear Station Units 1 and 2,Supplemental Information regarding Environmental Review, Ltr#WLG2013.03-01. (Accession No. ML13087A299)
March 22, 2013	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy to NRC, Duke Energy Carolinas, LLC, William States Lee III Nuclear Station – Docket Nos. 52-018 and 52-019, AP1000 Combined License Application for the William States Lee III Nuclear Station Units 1 and 2, Supplemental Information Regarding Environmental Review, Ltr#WLG2013.03-02. (Accession No. ML13087A201, ML13087A203)
April 3, 2013	Letter from Rebekah Dobrasko, Supervisor of Compliance, Tax Incentives, and Survey, State Historic Preservation Office, to Dr. Richard Darden, USACE, William S. Lee Nuclear Station, Cherokee County, South Carolina, P/N #2009-122-SIR, SHPO Project No. 06-RD0163. (Accession No. ML13220A505)

May 2, 2013	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy to NRC, Duke Energy Carolinas, LLC, William States Lee III Nuclear Station – Docket Nos. 52-018 and 52-019, AP1000 Combined License Application for the William States Lee III Nuclear Station Units 1 and 2, Supplemental Information's Related to Design Changes to the Lee Units 1 and 2 Physical Locations and Additional Design Enhancements, Ltr#WLG2013.05-02. (Accession Nos. ML13127A224, ML13127A225)
May 9, 2013	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy to NRC, Duke Energy Carolinas, LLC, William States Lee III Nuclear Station – Docket Nos. 52-018 and 52-019, Update for William States Lee III Nuclear Station Units 1 and 2 Combined License Applications, Ltr#WLG2013.05-03. (Accession No. ML13144A150)
May 29, 2013	Letter to Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy from Patricia J. Vokoun, Project Manager, NRC, Request for Additional Information Regarding the Environmental Review of the William States Lee III Nuclear Station, Units 1 and 2 Combined License Application. (Accession No. ML13150A311)
July 1, 2013	Letter from Christopher M. Fallon, Vice President, Nuclear Development, Duke Energy to NRC, Duke Energy Carolinas, LLC, William States Lee III Nuclear Station – Docket Nos. 52-018 and 52-019, AP1000 Combined License Application for the William States Lee III Nuclear Station Units 1 and 2, Response to Requests for Additional Information (RAI) 7106, 7118, 7120, 7122 and 7123, Ltr#WLB2013.07-02. (Accession No. ML13192A410)
September 25, 2013	Email from Pete Pattavina, U.S. Fish and Wildlife Services, Georgia Ecological Services Field Offices, to Jim Becker, Pacific Northwest National Laboratory. (Accession No. ML13317B647)

Appendix D

Scoping Comments and Responses

Appendix D

Scoping Comments and Responses

Two scoping processes were conducted for the environmental review of the William States Lee III Nuclear Station Units 1 and 2 (Lee Nuclear Station) combined licenses (COL) application. The initial scoping process was conducted in response to the application COLs for two new nuclear power reactors submitted by Duke Energy Carolinas, LLC (Duke) by letter dated December 12, 2007. The supplemental scoping process was conducted following the submittal by letter dated September 24, 2009, of the supplement to the environmental report describing Duke's plans to construct an additional off-site reservoir (Make-Up Pond C) to provide supplemental cooling water for the proposed Lee Nuclear Station Units 1 and 2.

On March 20, 2008, the U.S. Nuclear Regulatory Commission (NRC) published a Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process in the *Federal Register* (73 FR 15009). The Notice of Intent notified the public of the NRC staff's intent to prepare an environmental impact statement (EIS) and conduct scoping for the application for COLs received from Duke. The NRC invited Duke; Federal, Tribal, State, and local government agencies; local organizations; and the public to participate in the initial scoping process by providing oral comments at the scheduled public meeting and/or submitting written comments no later than May 20, 2008.

On May 24, 2010, the NRC published a Notice of Intent to Conduct a Supplemental Scoping Process for the Supplement to the Environmental Report in the *Federal Register* (75 FR 28822). The Notice of Intent notified the public that the NRC and the U.S. Army Corps of Engineers (USACE) were providing an additional opportunity to participate in the scoping process pertaining to the addition of Make-Up Pond C to the Lee Nuclear Station project scope. Once again, the NRC invited Duke; Federal, Tribal, State, and local government agencies; local organizations; and the public to participate in the supplemental scoping process by providing oral comments at the scheduled public meeting and/or submitting written comments no later than July 2, 2010.

Preparation of the EIS accounted for relevant issues raised during the initial and supplemental scoping processes. The comments received and addressed in NRC's environmental review are included in this appendix. They were extracted from the September 2008 *Environmental Impact Statement Scoping Process Summary Report, William States Lee III Combined License* (ADAMS Accession No. ML082390635) (NRC 2008) and the December 2010 *Environmental Impact Statement Supplemental Scoping Process Regarding Make-Up Pond C Summary Report, William States Lee III Nuclear Station, Units 1 and 2 Combined Licenses* (ADAMS

Accession No. ML103220015) (NRC 2010), and are provided for convenience of those interested specifically in the scoping comments applicable to this environmental review. Comment categories that are outside the scope of the environmental review for the proposed Lee Nuclear Station are not included in this appendix—they are included in their entirety in the scoping process summary reports cited above. These out-of-scope categories include comments related to:

- Safety
- Emergency Preparedness
- NRC Oversight for Operating Plants
- Security and Terrorism
- Support for or Opposition to the Licensing Action, Licensing Process, Nuclear Power, Hearing Process, or the Applicant.

The scoping process provides an opportunity for public participants to identify issues to be addressed in the EIS and highlight public concerns and issues. This appendix provides the comments and the NRC and USACE responses for the two public scoping processes held to support the preparation of this EIS. The Make-Up Pond C supplemental scoping process summary begins on page D-64.

D.1 The Initial Scoping Process

The initial public scoping meeting was held on May 1, 2008, at the Gaffney High School auditorium in Gaffney, South Carolina. The meeting summary and meeting transcript are available electronically in the NRC Public Document Room or from the Publicly Available Records component of NRC's Agency Document Access and Management System (ADAMS), which is accessible from the NRC website at http://www.nrc.gov/reading-rm/adams/web-based.html (the Public Electronic Reading Room; note that the URL is case-sensitive). The ADAMS accession numbers for the meeting summary and the meeting transcript are ML081420057 and ML081400038, respectively.

D.1.1 Overview of the Scoping Processes

At the May 2008 Gaffney meeting, 42 attendees provided oral or written comments that were recorded and transcribed by a certified court reporter. In addition to the oral comments and written statements submitted at the public meetings, the NRC received 18 emails and 8 letters containing comments during the scoping period. At the conclusion of the initial scoping period, the NRC staff reviewed the scoping meeting transcript and all written material received during the comment period and identified individual comments. These comments were organized according to topic within the proposed EIS or according to the general topic, if outside the scope of the EIS. Once comments were grouped according to subject area, the staff determined the appropriate response for the comments.

The comments from the initial scoping period and their responses were published in the *Environmental Impact Statement Scoping Process Summary Report, William States Lee III Combined License, Cherokee County, South Carolina* (ML082390635). To maintain consistency with the Scoping Summary Report, the correspondence identification (ID) number along with the name of the commenter used in that report is retained in this appendix.

Table D-1 identifies in alphabetical order the individuals who provided comments during the initial scoping period, their affiliations, if given, and the ADAMS accession number that can be used to locate the correspondence. Although all commenters are listed, the comments presented in this appendix are limited to those within the scope of the environmental review.

Table D-1. Individuals Providing Comments During the Initial Scoping Comment Period

Commenter	Affiliation (if provided)	Comment Source and ADAMS Accession #
Arnason, Deb	Self	Letter (ML081350290)
		Letter (ML081350296)
		Meeting Transcript (ML081400038)
Barczak, Sara	Southern Alliance for Clean Energy	Meeting Transcript (ML081400038)
		Letter (ML081430235)
Barrett, J. Gresham	State of South Carolina	Letter (ML081350302)
		Letter (ML081420610)
Batchler, James D.	Cherokee County Council	Letter (ML081350311)
Biggs, Diane	Self	Meeting Transcript (ML081400038)
Blackwood, Andy	Self	Meeting Transcript (ML081400038)
Blanton, Debbie	Self	Letter (ML081350307)
Blue, Lilly	Self	Meeting Transcript (ML081400038)
Boger, Paul	Greater York Chamber of Commerce	Meeting Transcript (ML081400038)
Bowers, Will	Self	Meeting Transcript (ML081400038)
Brown, Henry E.	State of South Carolina	Letter (ML081350302)
		Letter (ML081420610)
Chapman, A. Foster	Johnson Development Associates, Inc.	Letter (ML081350300)
Cherin, Mike	Self	Meeting Transcript (ML081400038)
Chisolm, Sarah	Self	Meeting Transcript (ML081400038)

Table D-1. (contd)

Commenter	Affiliation (if provided)	Comment Source and ADAMS Accession #
Clements, Tom	Self	Meeting Transcript (ML081400038)
Clyburn, James E.	State of South Carolina	Letter (ML081350302)
		Letter (ML081420610)
Connolly, Mary Ellen	Self	Meeting Transcript (ML081400038)
Cook, Jim	Cherokee County Development Board	Letter (ML081350305)
Cordeau, David	Spartanburg Area Chamber of Commerce	Meeting Transcript (ML081400038)
Craig, Anne	Self	Email (ML081400582)
Craig, Thomas	Self	Email (ML081440324)
Crockett, Mary	Broad Scenic River Advisory Council	Letter (ML081490598)
Commenter	Affiliation (if provided)	Comment Source and ADAMS Accession #
DeMint, Jim	South Carolina	Letter (ML081350302)
		Letter (ML081420610)
Dobrasko, Rebekah	South Carolina Dept. of Archives and History	Email (ML081510453)
		Email (ML081510939)
Dolan, Bryan	Duke	Letter (ML081350301)
		Meeting Transcript (ML081400038)
Ebert, Dick	Self	Email (ML081400581)
Forrester, Mike	Spartanburg Community College	Meeting Transcript (ML081400038)
Foster, Rufus H.	Cherokee County Council	Letter (ML081350311)
Gossett, Lewis	Self	Meeting Transcript (ML081400038)
Goudreau, Chris	North Carolina Wildlife Resources Commission	Email (ML081430390)
Graham, Lindsey	State of South Carolina	Letter (ML081350302)
		Letter (ML081410459)
Guild, Bob	Self	Meeting Transcript (ML081400038)
Hall, Timothy N.	U.S. Fish and Wildlife Service	Letter (ML081540399)
Halligan, Andy	Johnson Development Associates	Letter (ML081350618)
Hamrick, Mike	Self	Letter (ML081420612)
Hardy, Chris	York County Regional Chamber of Commerce	Meeting Transcript (ML081400038)
Hedges, Jean	Self	Email (ML081510940)
Houston, Kate	Clean and Safe Energy Coalition	Letter (ML081400579)

Table D-1. (contd)

Commenter	Affiliation (if provided)	Comment Source and ADAMS Accession #
Humphries, H. Baily	Cherokee County Council	Letter (ML081350311)
Inglis, Bob	State of South Carolina	Letter (ML081350302)
		Letter (ML081420610)
James, Andrew	Self	Meeting Transcript (ML081400038)
Johnson, David G.	Morgan Corp.	Letter (ML081400584)
Jolly, Henry L.	Mayor, Gaffney, South Carolina	Letter (ML081350303)
		Meeting Transcript (ML081400038)
Karpen, Leah R.	Self	Email (ML081420611)
Kohler, Elizabeth	Self	Email (ML081400580)
Little, Quay	Cherokee County Council	Letter (ML081350311)
Mathis, Charles	Cherokee County Council	Letter (ML081350311)
McDowell, Charlie	Congressman John Spratt	Meeting Transcript (ML081400038)
Minerd, Leslie	Self	Meeting Transcript (ML081400038)
Moorhead, Gene	Cherokee County Chamber of Commerce	Meeting Transcript (ML081400038)
Moss, Charles	Self	Meeting Transcript (ML081400038)
Moss, Dennis Carroll	State of South Carolina	Letter (ML081350312)
Murphy, William	Self	Meeting Transcript (ML081400038)
Olson, Mary	Southeast Office of Nuclear Information and Resource Service	Meeting Transcript (ML081400038)
Parris, Hoke	Cherokee County Council	Meeting Transcript (ML081400038)
		Letter (ML081350311)
Patrie, Dr. Lew	Western North Carolina Chapter of Physicians for Social Responsibility	Letter (ML081350304)
		Meeting Transcript (ML081400038)
Peeler, Harvey S.	State of South Carolina	Letter (ML081350309)
Perry, Robert D.	SC Dept of Natural Resources	Letter (ML081430553)
Poole, Mary Jane	Self	Email (ML081350616)
Richardson, Don	Self	Email (ML081510941)
Rudolf, Jerry	Self	Meeting Transcript (ML081400038)
Sandifer, Bill	State of South Carolina	Letter (ML081350308)
Saye, Jack	Self	Meeting Transcript (ML081400038)
Scott, G. Garrett	Johnson Development Associates	Email (ML081350617)
Smith, Karen	Self	Email (ML081440316)

Table D-1. (contd)

Commenter	Affiliation (if provided)	Comment Source and ADAMS Accession #
Smith, Nathan	Self	Meeting Transcript (ML081400038)
Sorensen, Laura	Self	Meeting Transcript (ML081400038)
Spencer, Tim	Cherokee County Council	Letter (ML081350311)
Spratt, John M.	State of South Carolina	Letter (ML081350302)
		Letter (ML081420610)
Sticpewich, John	Self	Meeting Transcript (ML081400038)
Stone, Bryan	Lockhart Power Company	Meeting Transcript (ML081400038)
Sutlock, Dot	Self	Email (ML081510942)
Tansey, Sara	Concerned Future Generations	Meeting Transcript (ML081400038)
Taylor, Joe	South Carolina Department of Commerce	Email (ML0851400583)
Thomas, Amber	Self	Email (ML081430229)
Thronberg, Bob	Self	Meeting Transcript (ML081400038)
Turk, Lawrence "Butch"	Self	Email (ML081510938)
Vogel, Chip	Draexlmaier Automotive of America LLC	Letter (ML081350300)
Waters, Jason	Self	Email (ML081410459)
White, Gayle	Self	Meeting Transcript (ML081400038)
Wilson, Joe	State of South Carolina	Letter (ML081350302)
		Letter (ML081420610)
Wolfe, Clinton	Citizens for Nuclear Technology Awareness	Letter (ML081350306)
		Meeting Transcript (ML081400038)
Woodward, Don	Spartanburg Development Association	Meeting Transcript (ML081400038)
Zeller, Lou	Blue Ridge Environmental Defense League	Meeting Transcript (ML081400038)

D.1.2 In-Scope Comments and Responses

The in-scope comment categories for the initial scoping process are listed in Table D-2 in the order that they are presented in this EIS. The comments and responses for the in-scope categories are included below the table. Parenthetical numbers shown after each comment refer to the comment ID number (correspondence number-comment number) and the commenter name.

Table D-2. Initial Scoping Comment Categories in Order as Presented in this Appendix

D.1.2.1 Comments Concerning the COL Process
D.1.2.2 Comments Concerning Land Use - Site and Vicinity
D.1.2.3 Comments Concerning Land Use - Transmission Lines
D.1.2.4 Comments Concerning Meteorology and Air Quality
D.1.2.5 Comments Concerning Hydrology - Surface Water
D.1.2.6 Comments Concerning Hydrology - Groundwater
D.1.2.7 Comments Concerning Ecology - Terrestrial
D.1.2.8 Comments Concerning Ecology - Aquatic
D.1.2.9 Comments Concerning Socioeconomics
D.1.2.10 Comments Concerning Historic and Cultural Resources
D.1.2.11 Comments Concerning Health - Radiological
D.1.2.12 Comments Concerning Accidents - Severe
D.1.2.13 Comments Concerning the Uranium Fuel Cycle
D.1.2.14 Comments Concerning Transportation
D.1.2.15 Comments Concerning Cumulative Impacts
D.1.2.16 Comments Concerning the Need for Power
D.1.2.17 Comments Concerning Alternatives - Energy
D.1.2.18 Comments Concerning Alternatives – System Design
D.1.2.19 Comments Concerning Alternatives - Sites
D.1.2.20 Comments Concerning Benefit-Cost Balance

D.1.2.1 Comments Concerning the COL Process

Comment: I was trying to understand if this environmental impact statement process is going to be amended as we go through this experiment. And that has to be built into the process. (**0001-128** [Clements, Tom])

Comment: I really don't understand the process. But I'm amazed to find out that it's going to take ten years to get these computers [power plants] on line. I just hope somehow that the environmental impact statement can be changed and monitored over that time. (**0001-153** [Saye, Jack])

***Response**: The licensing process for COL applications is specified in 10 CFR 52. The environmental review process associated with new reactor licensing includes a detailed review of an applicant's COL application to determine the environmental effects of building and operating the nuclear power facility for up to 40 years. After review of the application against the regulations and regulatory guidance, a mandatory hearing or optional contested hearing will determine whether it is appropriate for the NRC to grant the license. NRC approval of an application for a COL is not a foregone conclusion. Safety, as well as environmental issues, will be evaluated before a decision on an application is reached.*

Comment: We [Southern Alliance for Clean Energy] would like to comment on the difficulty with reviewing the application. Though we appreciate having the resources available online, it is very cumbersome to do so. (**0001-25** [Barczak, Sara])

Comment: We [Southern Alliance for Clean Energy] would like to comment on the difficulty with reviewing the application. Though we appreciate having the resources available on-line, it is a very cumbersome process to do so. Regular citizens and policymakers do not have the time to wade through these thousands of pages that have to be downloaded at times individually. I would guess that many people in this room have not even looked at one page of the application. And I cannot blame them given the frustration it has caused me. (**0010-5** [Barczak, Sara])

Comment: [The Southern Alliance for Clean Energy] would like to comment on the difficulty with reviewing the application. Though we appreciate having the resources available on-line, it is a very cumbersome process to do so. Regular citizens and policymakers do not have the time to wade through these thousands of pages that have to be downloaded at times individually. We recommend that the NRC require applications to be submitted in a more 'user-friendly' format. (**0049-13** [Barczak, Sara])

***Response**: The applicant's Environmental Report is available for public inspection at the NRC Public Document Room in Rockville, Maryland, and at the Cherokee County Public Library in Gaffney, South Carolina. The Environmental Report is also available electronically through the NRC's Agencywide Documents Access and Management System website at* http://www.nrc.gov/reading-rm/adams.html *and at http://www.nrc.gov/reactors/new-licensing/col/lee.html. The Public Document Room can also be contacted at http://www.nrc.gov/reading-rm/pdr/copy-service.html to request a paper copy or CD/DVD of the document for a fee. These comments do not provide information on the impacts of construction or operation of the proposed units on the environment and will not be addressed further in the EIS.*

Comment: I know that it's very difficult -- first of all, I have to say this -- the timing for people like myself who will be impacted by so many new proposed nuclear expansions and projects being rushed into existence all over the country, and especially here in the south. (**0001-64** [Arnason, Deb])

Comment: I find your timing very difficult for folks like myself who will be impacted by so many new proposed nuclear expansions and projects being rushed into existence all over the country and especially here in the South. (**0007-1** [Arnason, Deb])

Response*: Each applicant determines when to submit its COL application for a proposed project to the NRC. After the NRC accepts the application, it initiates the environmental review process in accordance with 10 CFR Part 51. These comments do not provide information on the scope of the environmental review for the proposed units and will not be addressed further in the EIS.*

Comment: [A]dd it up -- we are in seven combined operating license proceedings in this region. There is no other part of the United States that is having combined operating license applications for new nuclear power reactors. There are rumors that they may come in. So there's a lot going on and that lot that's going on has to be viewed as a phenomenon under NEPA. And I see it being chopped into a bunch of little pieces and I see federal money being spent and I see claims being made that are vast issues, like climate change, being addressed. (**0001-56** [Olson, Mary])

Response*: This comment expresses concern regarding the cumulative impacts of seven COL proceedings occurring at the same time but provides no specific information on the scope of the environmental review of the Lee COL application. Therefore, this comment will not be addressed further in the EIS.*

D.1.2.2 Comments Concerning Land Use - Site and Vicinity

Comment: 2.4.2.5.9 Recreation Areas. DNR appreciates acknowledgement of the Broad Scenic River Corridor as an outstanding natural resource and recommends Duke utilize the Broad Scenic River Management Plan (2003) as a resource in planning project operations. (**0046-17** [Perry, Robert D.])

Response: *Duke is a participant in and voting member of the Broad River Scenic Advisory Council. The Broad River is officially recognized by the South Carolina General Assembly as a State Scenic River (1991) that relies on river-bordering landowners, other local citizens, and the State Department of Natural Resources (DNR) working to conserve the river and its valuable resources consistent with the Council's mission. The NRC staff will evaluate resources such as the Broad River in Chapters 4 and 5 of the EIS.*

D.1.2.3 Comments Concerning Land Use - Transmission Lines

Comment: All activities associated with the construction and necessary operations of the Lee site should be considered a part of the project and considered in the EIS. Construction of transmission lines, roads and support structures may contribute to resource impacts that extend well beyond the foot print of the Lee site. Stormwater detention and retention capacities should be designed and constructed to adequately prevent contamination of adjacent land and water, particularly the Broad River. (**0045-10** [Hall, Timothy N.])

Comment: 2.2.2 Transmission Corridors and Onsite Areas, page 2.2-5. The ER states 2 transmission rights-of-way are proposed for the plant. On Dec 31, 2007 Duke advised DNR by letter and a 1-page 8.5 X 11.0 map, at scale of 1 in = 2 mi the approximate location of the 2 transmission corridors measuring (widths respectively) 200 ft (525 kV) and 150 ft (230 kV) and 325 ft (concurrent 525 and 230 kV). As of this date, DNR has not been provided with finalized routes and projected wetland impacts or impact acreages for proposed transmission corridor routes. Wetland impacts including clearing and fill proposed in transmission corridors will be subject to permitting requirements under Sections 401 and 404 of the US Clean Water Act. The SC Navigational Waters Act also requires permitting of overhead transmission corridors if waters defined by this legislation are crossed. (**0046-2** [Perry, Robert D.])

Response: *Environmental impacts associated with any planned new transmission rights-of-way will be addressed in the context of cumulative effects, as well as potential impacts associated with upgrades to the existing lines if required. The NRC does not have any regulatory authority regarding the implementation of Federal, State, and local guidelines in construction practices. The EIS will address any known or proposed activities that could impact the site or transmission corridor environmental conditions and proposed mitigation measures, as appropriate.*

Comment: In 1991, the South Carolina General Assembly passed legislation that recognized I believe it's a 15.3 mile stretch of the Broad River from Ninety-Nine Island, where this plant is at, all the way down to the peck (ph.) of the river. Duke was involved with this. The map that Duke sent me at the house, it shows that the transmission lines are going to follow the river almost per capita (sic). So I'd like to ask Duke Power, you were part of the Scenic Broad River Act, what's scenic about having an unGodly looking power line following the river? (**0001-105** [Moss, Charles])

Comment: Most importantly to a scenic river [forested uplands] are the reason it was declared scenic. If the upland forests are removed to provide area for transmission line corridors and structures the scenic viewshed could be affected. In order to improve and minimize impacts to this scenic viewshed, we recommend placing the transmission line structures and corridor away from the river where the natural ecosystem and viewshed disturbance will be less of an impact to the river. (**0042-7** [Crockett, Mary])

Response: *Duke is a participant in and voting member of the Broad River Scenic Advisory Council. Part of the Council's mission is to "…educate, protect, conserve, and be an advocate for the well being of the river through open communication with interested partners…[and to] work to develop responsible, limited and managed access to the resource and to maintain open lines of communication with other interested groups." Environmental impacts associated with any planned new transmission rights-of-way will be addressed in the context of cumulative effects.*

Comment: I am a resident of Cherokee County and this power line deal, my property is going to be impacted, this line is going to cross my property...we've had plans to build us a house and these folks have already been in there surveying and the survey team came right through where our living room was going to be. I don't think this is fair for Duke to be able to do this. (**0001-120** [Blackwood, Andy])

Response: *Environmental impacts associated with any planned new transmission lines and rights-of-way will be addressed in the context of cumulative effects. The NRC does not have any regulatory authority regarding the implementation of Federal, State, and local guidelines in the siting, construction, and maintenance of proposed transmission corridors and lines.*

D.1.2.4 Comments Concerning Meteorology and Air Quality

Comment: If in fact the federal money is being spent in the cause of trying to reverse the climate crisis; if in fact the federal spending for new nuclear power is to address climate, then it is incumbent upon NRC to assess the ability of nuclear power to do that job. We must evaluate whether nuclear energy can in fact impact and reverse the climate crisis. Is it the most cost-effective way to go? (**0001-54** [Olson, Mary])

Comment: When we think of how much we have changed our view of the climate and the environment in the last ten years and what comes with global warming and all the other aspects that have changed so much, hopefully the environmental impact statement will cover all those things. (**0001-154** [Saye, Jack])

Comment: Do we have proof that nuclear energy contributes significantly to reducing gas emissions? As yet the impact of climate change on nuclear operations is unclear. (**0034-7** [Karpen, Leah R.])

Response: *The NRC staff will evaluate the COL application based on the criteria described in NUREG-1555 (NRC 2000). In addition, the NRC staff will evaluate the proposed units' various gaseous emissions from both construction and operation, as well as emissions for a new coal- or natural gas-fired power plant constructed in the same location. The results of these analyses will be presented in Chapters 4, 5, and 9 of the EIS, respectively.*

Comment: I think that when evaluating the impacts of the expansion -- or the new reactors at the Lee site, that one part of the discussion really has to be whether or not nuclear energy is the response to climate change that everyone thinks it is. While I understand that it is emission free in its energy production, it is not at all emission free in its life cycle. When we're looking at environmental impacts of new nuclear reactors, we have to look beyond our community to the impacts on the state, on the country and on the world. (**0001-118** [Tansey, Sara])

Comment: I was a little bit shocked to see in the Duke fact sheet, and I also heard a couple of people say this, that nuclear power does not emit greenhouse gases. One of the previous speakers pointed out that you have to look at the entire nuclear fuel cycle. This is simply not true. The mining of uranium, which takes place in the United States on a lot of native lands, the milling, the enrichment of uranium at enrichment plants uses a huge amount of energy. Then you have to count the construction costs, managing the nuclear waste, taking apart the plant in the future and dealing with the waste far, far into the future. (**0001-132** [Clements, Tom])

Comment: [N]uclear fuel production causes air pollution. (**0001-140** [Patrie, Dr. Lew])

Comment: Despite nuclear industry's assertions that nuclear energy is clean, nuclear fuel production causes air pollution. (**0015-3** [Patrie, Dr. Lew])

Comment: Where's the proof that nuclear energy can contribute significantly to reducing greenhouse gas emissions - particularly in the immediate, most critical period of time, and when accounting for all life cycle emissions? (**0038-8** [Turk, Lawrence "Butch"])

Comment: The EIS should consider the potential environmental impacts associated with production of raw materials for the new nuclear site, as well as any related improvements in infrastructure necessary to bring those raw materials into the Lee site or to transport hazardous wastes from the site. Please consider the entire supply chain, transportation, use, and disposal in your analysis of these air quality effects. (**0045-1** [Hall, Timothy N.])

Response: *The NRC staff will evaluate impacts from the life-cycle of fuel production, construction, operation, and decommissioning of the plant. The results of this analysis will be presented in Chapters 4, 5, and 6 of the EIS. The generic impacts of the fuel cycle are codified in 10 CFR 51.51(b), Table S-3, "Table of Uranium Fuel Cycle Environmental Data." Per the guidance in 10 CFR 51.51, the staff will rely on Tale S-3 as a basis for the impacts of uranium fuel-cycle impacts (including fossil emissions) to include uranium mining and milling.*

Comment: I'm just wondering how you model the effects of 35 million gallons of water a day or more going to water vapor so close to the mountains. What effect is that going to have? How is that modeled? (**0001-155** [Saye, Jack])

Response: *The NRC staff will evaluate the effects of the cooling tower plumes associated with the new units following the guidance described in NUREG-1555. The standard computer model used in this analysis is the Seasonal-Annual Cooling Tower Impact Prediction Code, which is explicitly designed to represent cooling tower plumes. Analysis results will be presented in Chapter 5 of the EIS.*

Comment: Concerns about air and restrictions of sulfur dioxide, nitrous oxide and mercury are what we hear about. Nuclear can generate 24/7 with no greenhouse gas emissions. (**0001-76** [Blue, Lilly])

Comment: [S]ome claim that nuclear power cannot tangibly affect climate change and will cause staggering emissions. The fact is that each plant offsets the emission of tens of millions of tons of carbon dioxide annually. (**0001-83** [James, Andrew])

Comment: We are looking at more stringent federal ozone requirements in this region and we need to generate more power, but we have to do it in an age where reducing greenhouse gas is a national priority. For this region, nuclear power is the best method to generate energy and to help us meet those federal air quality standards at the same time. (**0001-95** [Gossett, Lewis])

Comment: At the same time, nuclear energy has a small carbon footprint and contributes to the United States quest to reduce carbon emissions and other air pollutants (**0016-2** [Cook, Jim])

Comment: At the same time, nuclear energy has a small carbon footprint and contributes to the United States quest to reduce carbon emissions and other air pollutants. (**0047-2** [Vogel, Chip])

Response: *The NRC staff will evaluate the proposed units' gaseous emissions. The results of this analysis will be presented in Chapter 5 of the EIS. The NRC staff will evaluate emissions associated with the construction of either a coal- or natural gas-fired power plant. The results of this analysis will be presented in Chapter 9.*

D.1.2.5 Comments Concerning Hydrology - Surface Water

Comment: Duke and the NRC should know that we are currently suffering from drought. Yet Duke's application references the 2005 South Carolina water use report summary that says the last multi-year drought was in 1998. Well, guess again, we're in a severe one now and Duke should have mentioned that in the application. The NRC certainly must address this as it

prepares the draft EIS. According to Duke's application, and the NRC will have calculations to figure this out, the two Lee reactors will withdraw, during normal use, over 47 million gallons of water per day from the Broad River and will consume or lose an average of 35 million gallons per day, returning only one-quarter back to the river. The maximum withdrawal will be over 81 million gallons per day with maximum consumption of over 41 million gallons per day. So overall, the loss will be approximately 50 to 75 percent. That is unacceptable.
(**0001-18** [Barczak, Sara])

Comment: The application also mentions that average surface water use -- and this is for both public and industrial -- in Cherokee County was 8.4 million gallons per day. This means that on a daily basis, the Lee plant will use six to ten times the amount of surface water used by everyone else in the county combined -- six to ten times the amount. (**0001-19** [Barczak, Sara])

Comment: The plant will be competing [for water] with other important uses in South Carolina and the region, and the application does not acknowledge the impacts this may have, nor does it discuss the impacts this could have during severe drought conditions such as we are currently experiencing. That has to be considered in the draft EIS. (**0001-20** [Barczak, Sara])

Comment: The Broad River is already stressed from the drought and from a variety of industrial and municipal users. Duke also has efforts to expand the Cliffside plant in North Carolina, which also aims to take huge amounts of water from the Broad River. The full extent of these proposed impacts are not discussed in the application. The NRC needs to analyze not only the Broad River of today but the Broad River of tomorrow, which is slated for more development. The application even states that an estimated 56 percent increase in water demand is projected from 1997 to 2020 for the North Carolina portion of the Broad River basin alone. How will the Broad River be able to provide enough water for all these needs?
(**0001-21** [Barczak, Sara])

Comment: Duke's nuclear power plants, if constructed on the Broad River, would use many more times the water supply than all of Cherokee County's homeowners, municipal water suppliers and industrial users on this river. (**0001-28** [Zeller, Lou])

Comment: We will also be looking at water impacts. We're teaming up with a number of groups working on coal, working on water, and we will be definitely examining what kind of a realistic basis you are addressing in terms of communities having to negotiate and sign deals and political brokering over having drinking water -- drinking water in the southeast recently. What is the impact of adding two more generating units that require such vast amounts of water.
(**0001-52** [Olson, Mary])

Comment: I do understand that there are drought problems through Alabama, Georgia, North Carolina, South Carolina, Florida and I know that Duke has had problems this past year. The drought shut down -- Duke had problems when water levels dropped on Lake Norman. There's another article here drought may shut down nuclear reactors. (**0001-65** [Arnason, Deb])

Comment: The concern I mentioned is that we do have a hydro-electric plant downstream of the proposed site on the Broad River. A lot of water is going to flow out of the Broad River for cooling. From the brief amount that I read, the idea is that it will be used for cooling and then it in turn -- but that heats the water up -- in turn it will be cooled back down so that it's put back into the river at the temperature that approximates what it's taken out at, to minimize that impact on the river and the ecology. I understand also is that there will be some amount of evaporative losses associated with that. There'll be water that will permanently be lost from the Broad River. As a hydro-generation owner that's downstream of this plant, obviously that's an impact. The more water that's removed and also lost from the river, the less that we will be able to generate in hydro-generation. We're not the only hydro-generator downstream of this proposed site. There are a number of hydro-generators downstream that could include some of Duke's as a matter o fact. So I'm sure they're aware of that proposed problem. The question is, you know, what's a fair balance between having this water that's lost to generate nuclear energy and the loss to those that need to generate renewable hydro-generation, hydroenergy. (**0001-100** [Stone, Bryan])

Comment: There's not going to be enough water in the Broad River to cool the reactor. They're going to have to build a lake, a major lake. They ain't going to cool that thing down, it's going to blow up and kill everybody in 50 miles. (**0001-122** [Blackwood, Andy])

Comment: When I look at the environmental documents that are posted on the NRC website, I noticed that a certain low flow of the river was chosen and that Duke, even using their figure, that 16 percent of the river was going to be used, not just withdrawn, but actually used. And I know that the NRC has been reluctant to analyze the impact during severe drought situations, which is what we're in now. (**0001-129** [Clements, Tom])

Comment: [T]he Cliffside coal plant upstream, and downstream there are two more reactors that South Carolina Electric & Gas has said that they're looking at also on the Broad River. So this environmental impact statement has to look at the cumulative impacts of the river -- on the river. (**0001-131** [Clements, Tom])

Comment: I ask the Nuclear Regulatory Commission to examine the effects of drought and decreased water on the state of South Carolina. (**0001-163** [Smith, Nathan])

Comment: I also request that they investigate the impacts of climate change on this proposed plan and how the possible increase in water temperature will affect it. (**0001-164** [Smith, Nathan])

Comment: Cooling towers use massive amounts of water in addition to the water demand of the plant itself. (**0001-190** [Connolly, Mary Ellen])

Comment: With drought conditions getting worse each summer, we may very well need to go to the Broad for a water source. Last -- just before the last rain started, you could almost walk across the Broad River as well as the Catawba River. We are the fastest growing county in the state and the second or third fastest growing in the nation. We cannot afford another massive water user such as a nuclear power plant. This is a beautiful scenic river and has been an historical asset to our county. (**0001-194** [Connolly, Mary Ellen])

Comment: At the nuclear power plant itself, I am concerned about the huge amount of water needed in the energy production and its possible/probably contamination. (**0005-2** [Craig, Anne])

Comment: With the drought conditions that so severely impacted these States this past year, I find this [proposal to build a new nuclear reactor in Gaffney, SC] unbelievable. I'm sure you are aware that nuclear energy is such a water guzzler, worse than the population, because it evaporates the water instead of returning it to the ground. With water wars already in place in GA, AL, LA, NC, SC and FL, how could Duke even contemplate such a move or the NRC take it seriously? (**0007-2** [Arnason, Deb])

Comment: Where will the water come from to cool this proposed new reactor? (**0007-3** [Arnason, Deb])

Comment: Duke and the NRC should already know that we are currently suffering from a historic drought. Yet Duke's application references the 2005 South Carolina Water Use Report Summary that says the last multi-year drought was in 1998. Well, guess again. We're in a severe one now and Duke should have mentioned that in the application and the NRC certainly must consider this as it prepares the draft EIS. According to Duke's application, the two Lee reactors will withdraw during normal use over 47 million gallons of water per day (mgd) from the Broad River and consume, or lose, on average over 35 mgd, returning only one quarter back to the river. The maximum withdrawals will be over 81 mgd with maximum consumption of over 41 mgd. So overall consumptive loss will be approximately 50-75%. That is unacceptable. (**0009-8, 0049-7** [Barczak, Sara])

Comment: The application also mentions that average surface water use (public and industrial) in Cherokee County was 8.4 million gallons per day. This means that on a daily basis the Lee plant could use six to ten times the amount of surface water used by everyone else in the county combined. The plant will be competing with other important water users in South Carolina and the region. Yet, the application does not acknowledge the impacts this may have,

nor does it ponder the impacts this could have during severe drought conditions, such as we are currently experiencing. The NRC needs to address this in the draft EIS.
(**0009-9, 0049-8** [Barczak, Sara])

Comment: The Broad River, from which the Lee site will rely, is already stressed from the drought and a variety of industrial and municipal users. Further, other proposals, such as Duke's efforts to expand the Cliffside coal plant in NC, also aim to use huge amounts of water from the Broad River. The full extent of these proposed impacts are not discussed in the application. The NRC needs to analyze not only the Broad River of today but the Broad River of tomorrow, which is slated for more development. The application even states that an estimated 56 percent increase in water demand is projected from 1997 to 2020 for the North Carolina portion of the Broad River basin. How will the Broad River be able to provide enough water for all these needs? (**0010-1, 0049-9** [Barczak, Sara])

Comment: Nuclear power plants require tremendous amounts of water for their operation. Specifically, how much water will be used, how much returned to the source, how much will escape as steam? What will be the source of water, and how much? Have climate changes been considered? (**0034-3** [Karpen, Leah R.])

Comment: Duke's nukes would consume 4 times as much water as all public and industrial users in Cherokee County combined (Duke License Application Environmental Report Section 2.3.2). This water usage would put all residents at risk because this is Cherokee County's only water source. (**0035-4** [Hamrick, Mike])

Comment: The recent droughts have increased the public's awareness of the limited availability of water in the Broad River basin. A number of municipalities are investigating the potential to increase their water withdrawals or to construct new storage reservoirs or intake facilities. This trend is likely to continue over the term of the proposed nuclear facility as human demand for water increases with increased population size. We want to be assured that the hydrology of streams in North Carolina will not be altered in order to provide cooling water for the nuclear project. This could occur in several ways. Water could be diverted directly from the Broad River basin or another basin in North Carolina. Another possibility is that water stored in existing or future reservoirs could be allocated to meet the cooling water needs for the Lee facility. In either event, it is likely that the flow regime in North Carolina streams and rivers would be altered in terms of magnitude, duration, timing, frequency or rate of change. The EIS should assess whether the nuclear project is able to operate throughout the projected license term without altering the hydrology of North Carolina streams. Any existing or potential interbasin transfer infrastructure and facilities should be included and discussed in detail in the EIS. (**0037-4** [Goudreau, Chris])

Comment: A nuke requires millions of gallons of water - in some cases per day, in some cases per minute. Where will the water come from? How much will be returned to that source and how much will leave the site as steam? How will that water sacrifice impact our environment, agriculture, and local water supplies including drinking water? Are climate change projections factored in? (**0038-3** [Turk, Lawrence "Butch"])

Comment: What water will cool these reactors? Who else needs that water? What if the long drought predicted comes true? (**0041-1** [Sutlock, Dot])

Comment: We are also concerned about the amount of water needed to run and shutdown the proposed facility and would want to read about a water supply study and plan for low water periods. (**0042-6** [Crockett, Mary])

Comment: 2.4.1.1 Existing Cover Types, page 2.4-3. The ER states that Make-up Pond B was created by damming McKown's Creek, a perennial stream. Likewise, Hold-up Pond A was created by damming a small stream and backwater of the Broad River and Make-up Pond A by damming a backwater of the river. These impacts also should be included in the discussion of environmental impacts contained within Chapters 4 and 10. (**0046-8** [Perry, Robert D.])

Comment: 2.4.2.6. Waters of the United States. The ER identifies the section of the Broad River upstream of the Ninety-Nine Islands dam as not being an interstate navigable water (Section 10 US Navigable Water). However, it is a State navigable water, subject to permitting requirements pursuant to South Carolina R.19-450 under the State Navigable Waters Act.

The ER references Fig. 2.4-1 as a map of jurisdictional waters of the US and refers to 8 onsite stream channels as jurisdictional waters of the US, but these areas are not identified in Fig. 2.4-1. It also is not clear whether onsite impoundments are jurisdictional waters of the US. Duke should submit for review a map with all waters of the US clearly identified.
(**0046-18** [Perry, Robert D.])

Comment: 4.1.1.2 The Vicinity, page 4.1-3. Potential impacts are considered only for National Scenic Rivers, of which there are none within the vicinity of the project. DNR submits impacts be considered not only for National Wild and Scenic Rivers, but also for the state-designated Broad Scenic River immediately downstream of the site. (**0046-20** [Perry, Robert D.])

Comment: 5.3.1.1.3. Operations During Low Flow Conditions, page 5.3-3. The Broad River basin upstream of the Gaffney gauge incurs low to moderate regulation due to upstream hydropower operations. These hydropower projects are run-of-the-river projects at normal to high flows, but impacts from these facilities are very noticeable during low instream flow periods. Though the methodology employed by Duke is sometimes used by the United States Geological Survey (USGS) in computing 7Q10 values, the usefulness of this value is questionable due to the existing stream regulation throughout much of the upper Broad River basin, and it is not a value occurring under natural conditions. DNR hydrologists generally discourage using 7Q10 values for instream minimum flows and oppose the 479 cfs value computed by Duke because of impacts of stream regulation on low flows.

There are 2 published 7Q10 values on the Broad River at the Gaffney gauge, both of which only use measured data at the site. Steinert (1989) in the SCWRC Report No. 166 indicated a value 562 cfs, while a 1991 USGS Water Resources Investigations Report (91-4170) demonstrated a value of 540 cfs. Neither of these reports includes data from the 1998-2002 droughts, which may lower the 7Q10 value.

DNR hydrologists have computed synthetic hydrographs for the Broad River at the Gaffney gauge using alternative methods disregarding the Blacksburg gauge. This was done to show the impacts of using the Blacksburg gauge (downstream from the Gaston Shoals Hydroelectric Development). First, the area proration method was used for all the data gaps at the Gaffney gauge based solely on the Boiling Springs, NC gauge including the 1997-2006 period. A second hydrograph was developed using a correlation between the Boiling Springs gauge and the Gaffney gauge ($R^2 = 0.90$). These hydrographs produced 7Q10 values in the range of 530-540 cfs, over 50 cfs higher than the value computed by Duke. These computations were calculated to show use of the Blacksburg data tends to lower the 7Q10 value from what may occur naturally due to the impacts of regulation at the Gaston Shoals Hydroelectric Development during low flow periods.

Minimum flows in the Broad River at the Ninety-Nine Islands reservoir are regulated by Federal Energy Regulatory Commission (FERC) license: 966 cfs January through April; 725 cfs May, June, and December; and 483 cfs July through November. However, there are several places in the ER where the 7Q10 value is quoted when discussing water availability during low flow conditions (see section 3.3.1.1 for example). If minimum flows are indeed designated by the existing FERC license then references to the 7Q10 value should be avoided when discussing water availability during low flow conditions.

In section 5.3.1.1.3 an analysis was done to determine when and how long the proposed nuclear plant would have had to shut down due to water shortages based on the 1926-2006 historic hydrograph. The threshold flow under which water would start to be withdrawn from Make-Up Pond B was 538 cfs (483 cfs +55 cfs). The 483 cfs value, the minimum FERC flow for July through November, was used for all 12 months. The same analysis should be repeated using seasonally based minimum flows stipulated from the FERC license. Though water shortages are most likely to occur during the dry season (July through November), designated seasonal minimum flows may serve to prolong water shortage periods and potentially increase the frequency of water shortages. A DNR analysis has been done to reconstruct the same synthetic hydrograph Duke computed using the area proration method. The 42 consecutive days of curtailed operation during 2002 listed in section 5.3.1.1.2 of the ER would be increased to 61 days when considering the seasonally based flows as required by the FERC license.

DNR hydrologists also repeated this analysis using the synthetic hydrograph based on the regression relationship developed between the Gaffney gauge and the Boiling Springs gauge. The analysis also subtracted current net withdrawal from the river between the 2 gauges as determined from the Broad River Water Supply Study (approximately 27 cfs). This analysis improves water availability outlook under the minimum flow requirements from the FERC license by reducing the number of days the plant would have to shut down during 2002 to 25 days. These results also show minimum flows stipulated by the FERC license will have limited impacts on plant operations. However, DNR emphasizes the need to increase Lee Site off-stream water reserves to further ensure future operations and electric generation be uninterrupted due to limited but needed water availability**.**

Duke, as documented in the Broad River Water Supply Study and section 2.3.1.3.3 of the ER, is planning an expansion of their Cliffside Electric Generation Station. Duke currently withdraws 6.72 MGD (10.4 cfs) from the Broad River at Cliffside, and by 2015, the withdrawal is expected to be 20.68 MGD (32.1 cfs), giving a net increase of 14 MGD (23 cfs) in the total withdrawal. In addition, the North Carolina water demand is projected to increase by 23 cfs by 2020 (section 2.3.2.1.4) in the Broad River basin. The low flow analyses in section 5.3.1.1.3 based on the historic hydrograph do not appear to take into account these projected increases in water withdrawals (or any other projected withdrawals as described in the Broad River Water Supply Study). DNR encourages a more complete analysis of water availability issues and water shortages during low flow conditions, taking into account future water withdrawal projections. Given the frequency and severity of droughts over the past 10 years and the projections of future water demand in the Upper Broad River basin, DNR is concerned with potential water shortages and plant shutdowns. How dependent will this region become on this plant and how could the loss of a substantial amount of power for weeks to months at a time affect this region now and in the future? Will the plant become so vital to future power needs that future minimum flow requirements will be compromised? DNR recommends developing additional backup water reserves in addition to Make-Up Pond B to lessen the potential for plant shutdowns and to avoid water availability conflicts in the future. Back up water reserves should be sufficient to cover the longest consecutive projected plant shutdown based on the historic hydrograph record. DNR recommends the proposed Lee Site plant operations be consistent with the guidance and policies described within the SC State Water Plan, 2nd Edition which can be viewed at http://www.dnr.sc.gov/water/admin/pubs/pdfs/SCWaterPlan2.pdf. (**0046-26** [Perry, Robert D.])

Response: *The construction and operation of a nuclear plant involves the consumption of water. The staff will independently assess the impact of these consumptive water losses on the sustainability of both the local and regional water resources. This assessment will consider both current and future conditions, including changes in water demands to serve the needs of the future population, and changes in water supply. While the NRC does not regulate or manage water resources, it does have the responsibility under NEPA to assess and disclose the impacts* *of the proposed action on water resources. The staff's assessment of the impacts on the sustainability of water resources will be presented in Chapters 4 and 5 of the EIS for construction and operation, respectively. In addition, staff will evaluate system design alternatives, including cooling water systems, and mitigation measures in Chapter 9.*

Comment: In terms of water, nuclear power plants have a large impact on water quantity and quality, they release radioactive contaminants and hazardous chemicals into our water resources, they contribute to thermal pollution, they negatively impact aquatic life and they definitely require more water than other forms of energy and significantly more water than energy efficiency and clean energy technologies such as solar and wind. This is not mentioned in the application. (**0001-17** [Barczak, Sara])

Comment: [N]uclear plants cause thermal water pollution (**0001-139** [Patrie, Dr. Lew])

Comment: Nuclear power plants have a large impact on water quantity and quality. Nuclear power plants release radioactive contaminants and hazardous chemicals into surrounding water resources, contribute greatly to thermal pollution, negatively impact aquatic life, and require enormous volumes of water in order to operate-requiring more water use than other traditional forms of energy production and significantly more water than energy efficiency measures and clean energy technologies such as solar and wind. (**0009-7, 0049-6** [Barczak, Sara])

Comment: Despite nuclear industry's assertions that nuclear energy is clean, nuclear plants cause thermal water pollution. (**0015-2** [Patrie, Dr. Lew])

Comment: We would also like to recommend that all the storm water and runoff from any development or construction be collected and filtered/treated before it is allowed to enter the riparian areas of the Broad River or the Broad Scenic River. (**0042-3** [Crockett, Mary])

Response: *The construction and operation of a nuclear plant involves some discharges to nearby water bodies. The Clean Water Act designated the U.S. Environmental Protection Agency as the Federal agency with responsibility over effluent discharges to the nation's waters. While it only regulates radiological effluents, the NRC does have the responsibility under NEPA to assess and disclose the expected impacts of the proposed action on water quality throughout the plant's life. The staff's assessment will consider whether the designated uses of the local and regional water supplies are jeopardized by the construction or operation of a nuclear plant at the proposed site. The staff's assessment of the nonradiological impacts to water quality will be presented in Chapters 4 and 5 of the EIS for construction and operation, respectively, while radiological impacts during operation will be presented in Chapter 5. Any cumulative effects will be address in the cumulative effects section of the EIS.*

Comment: 5.2.3.1 Thermal Impacts, page 5.2-10. DNR requests the CORMIX model and associated data used to evaluate thermal impacts associated with blowdown discharge from the cooling towers be provided to staff for review. (**0046-24** [Perry, Robert D.])

Response: *The NRC has requested input data for the CORMIX model from the applicant and will run the model as a part of its analysis of thermal impacts.*

D.1.2.6 Comments Concerning Hydrology - Groundwater

Comment: 2.3.1.5.4 Topography, page 2.3-16 Paragraph 3 indicates numerous springs (20) and seeps were identified during the 1973 investigation. These springs and seeps were cut or filled in order to level natural drainage and flatten the construction yard during the initial construction phase of the Cherokee facility. However, the ER does not include these impacts in the description of Environmental Impacts of Construction in Chapter 4. Impacts associated with the original construction that occurred in the 1970s supporting active operations of the proposed facility should be included in the description of environmental impacts in Chapter 4. (**0046-3** [Perry, Robert D.])

Response: *Staff will evaluate and disclose the impacts of Duke's current construction activities in Chapter 4 of the EIS. Impacts from construction of the Cherokee facility in the 1970s will be addressed in the cumulative effects section of the EIS.*

D.1.2.7 Comments Concerning Ecology - Terrestrial

Comment: I would encourage the environmental impact statement to look at what wildlife in Cherokee County can benefit from the conservation program and open land provided by the nuclear power plant. (**0001-125** [Chisolm, Sarah])

Response: *Wildlife on the Lee site, as well as any benefits derived from the open land onsite and conservation programs in which Duke Power participates, will be described in Chapter 2 of the EIS.*

Comment: The proposed project may include destroying vegetation near the river and surrounding areas in order to place transmission line corridors and buildings associated with the construction of a nuclear power station. (**0042-1** [Crockett, Mary])

Comment: Forested uplands draining into the river floodplain and riparian areas perform numerous wildlife habitats, hydrologic, and water quality functions that provide significant and well-documented public benefits. Additionally, floodplains and riparian areas can help to alleviate downstream flooding. Most importantly to a scenic river they are the reason it was declared scenic. (**0042-2** [Crockett, Mary])

Response: *Upland forests, floodplains, riparian areas, and wetlands and their function will be described in Chapter 2 of the EIS. The potential impacts of construction to these systems on the Lee site and along new transmission rights-of-way will be described and evaluated in Chapter 4 of the EIS or as a cumulative effect as appropriate. The scenic river status of the Broad River will also be addressed in these chapters.*

Comment: The EIS should present a detailed analysis of potential impacts to federally protected species as a result of the construction and operation of the Lee site. Although the main facility may be located in Cherokee County, infrastructure development, mining operations and supply components are an integral part of the reactor facility and must be review for impacts to threatened and endangered species. (**0045-5** [Hall, Timothy N.])

Response: *Federally and State-ranked species within the areas affected by this project will be described in Chapter 2 of the EIS. The potential impacts of construction and operation on Federal and State-listed species on the proposed Lee site will be described and evaluated in Chapters 4 and 5 of the EIS. However, impacts of activities at unspecified locations, such as mining operations, are not within the scope of this review and will not be addressed in this EIS.*

Comment: The [U.S. Fish and Wildlife] Service does have records of smooth coneflower (*Echinacea laevigata*) from near the Cherokee County project site. We recommend a field survey to determine the presence or absence of this species and its habitat. The listed T&E species include Federal species of concern that are currently under status review by the Service and may occur in the project impact area. Federal species of concern are not legally protected under the Act and are not subject to any of its provisions, including Section 7, unless they are formally proposed or listed as endangered or threatened. We are including these species in our response to give you advance notification and to request that any surveys include these species as well. The presence or absence of these species in the project impact areas should be addressed in the environmental assessment. We encourage you to consider alternatives which minimize impacts to these species and their habitats that may be present in the area of affect of the project. (**0045-7** [Hall, Timothy N.])

Response: *The Federally listed endangered smooth coneflower (Echinacea laevigata) was not noted as a species of interest to the U.S. Fish and Wildlife Service (FWS) in its letter to Duke on May 23, 2006. Thus, botanical surveys of the Lee site conducted to date have not included this species. The NRC staff will contact the FWS to confirm this species recorded location near the Lee site. The potential for the species' occurrence onsite will be assessed based on the species' habitat affinities and whether such habitats were observed onsite during the surveys conducted to date. The decision to conduct surveys for the smooth coneflower onsite will be made at that time. If surveys are conducted, the results will be described in Chapter 2 of the EIS. If the species is present onsite, potential impacts and any impact avoidance, minimization, or mitigation measures will be addressed in Chapter 4.*

Comment: Potential impact to migratory bird populations and movement should also be analyzed. We are concerned about impacts of potential bird collisions, or electrocution. We believe that a monitoring program should be developed consistent with the MOA between the [U.S. Fish and Wildlife] Service and NRC for migratory birds. Since bald eagles, osprey, black and turkey vultures, and herons frequent the project vicinity, we recommend any associated transmission lines or distribution lines crossing wetlands, large bodies of water, or open areas should be maintained to maximize visibility of the line to raptors by one of the following design modifications: (1) remove the static line; (2) enlarge the static line to improve visibility to raptors; or (3) mount aviation balls or similar markers on the static line. How will stormwater basins, settling ponds, lagoons, and other storage facilities be designed and managed to minimize impacts to migratory birds, including waterfowl? (**0045-8** [Hall, Timothy N.])

Response: *The design of the transmission lines is outside the scope of this review, as the NRC does not license transmission line construction. Therefore, design alternatives will be not be evaluated in the EIS; however, the potential impacts to migratory birds and mitigation measures will be evaluated in the cumulative effects section of the EIS. In addition, the potential effects of any stormwater basins, settling ponds, lagoons, or other such storage facilities on migratory birds (including waterfowl), and any mitigation measures to reduce such impacts, will be addressed in Chapter 5.*

Comment: We are concerned about the effects of night security lighting. We are primarily concerned about the potential for overlighting the large site and the potential adverse effects on fish and wildlife resources in the area, including migratory birds and bats. A dark nighttime sky is essential. Contributions of light from the earth (both direct emissions and reflected light) brighten the night sky background. This brightening also greatly diminishes the view of the sky for migrating birds, moths, bats, and the general public. (**0045-9** [Hall, Timothy N.])

Response: *Potential impacts on wildlife—including migratory birds and bats—from nighttime security lighting will be addressed in Chapter 5 of the EIS.*

Comment: We are also concerned with the introduction and spread of invasive exotic species in association with the proposed project. Without active management, including the revegetation of disturbed areas with native species, project corridors will likely only be sources of (and corridors for) the movement of invasive exotic plant species. Despite their short-term erosion-control benefits, many exotic species used in soil stabilization seed mixes are persistent once they are established, thereby preventing the reestablishment of native vegetation. Many of these exotics plants are also aggressive invaders of nearby natural areas, where they are capable of displacing already established native species. Therefore, we strongly recommend that only native plant species be used in association with all aspects of this project, including secondary impacts (i.e., connecting sewer lines). (**0045-12** [Hall, Timothy N.])

Response: *The potential impacts of construction, including impacts due to exotic species invasion and seeding non-native species in disturbed areas to control erosion, will be addressed in Chapter 4 of the EIS or as a cumulative effect as appropriate. The minimization of such impacts via seeding or otherwise facilitating the re-establishment of native vegetation in disturbed areas will also be addressed in Chapter 4.*

Comment: 2.4.1 Terrestrial Ecology, page 2.4-2. The ER references the Cherokee Nuclear Station Environmental Report (Cherokee ER) issued by Duke Power Company on October 13, 1975. However, Duke has not provided the Cherokee ER as an Appendix for reference. Since Duke relied heavily on the results of the Cherokee ER in the development of the ER for the Lee Site, it will be necessary to review the Cherokee ER. Likewise, the ER references a 2006 *reconnaissance* study of terrestrial species and resources, but has not provided methods and study results in the form of an appended technical report. This information will be needed to appropriately evaluate the scope, intensity and effort of cited studies as conducted to support the license application. (**0046-6** [Perry, Robert D.])

Comment: 2.4.1.1 Existing Cover Types, page 2.4-2. The ER indicates *previous terrestrial ecological conditions were extensively altered by grading and construction for the Cherokee Nuclear Station*. These impacts should be included in the discussion of terrestrial impacts of construction in Chapter 4. (**0046-7** [Perry, Robert D.])

Comment: 4.2 Water Related Impacts, page 4.2-1. The ER states construction related impacts to wetland areas are expected to be small because the site requires few changes to aquatic habitats to accommodate the construction of a new plant, since *much of the potential water-related modifications of this site were made during original construction of the Cherokee plant.* It is not known whether a Section 404 permit was issued for the construction of the Cherokee plant and whether mitigation for these initial impacts was required or provided at that time. The existing impoundments and construction foundation for the 2 future nuclear units will be utilized for the active operation of the Lee Nuclear facility. These impacts are significant and should be included in environmental impacts due to construction to ensure that total impacts to waters of the US may be appropriately evaluated and mitigated. For example, <u>a cursory review of USGS topographic maps indicates that [plus or minus] 11,000 lf of perennial and intermittent stream were filled and flooded for the construction of the impoundments alone</u>.
(**0046-21** [Perry, Robert D.])

Response: *The Cherokee Nuclear Station Environmental Report (Cherokee ER; Duke Power Company 1974) and the Section 404 Permit will be reviewed in light of information presented by Duke in its ER for the Lee COL. These documents will be used to develop the Lee COL EIS and will be referenced appropriately. Impacts of construction of the Cherokee facility will be addressed in the cumulative effects section of the EIS. A report documenting the methods, level of effort, and results of the reconnaissance field surveys (referenced by Duke in its ER for the Lee COL) has been requested from Duke and will also be evaluated to develop the Lee COL EIS.*

Comment: 2.4.1.1.1 Alluvial and Other Wetlands, page 2.4-6. Jurisdictional and nonjurisdictional wetlands have been identified onsite and Duke obtained an Approximate Jurisdictional Determination by the US Army Corps of Engineers on September 24, 2007. The ER indicates a Section 404 permit will not be required for further construction because none is planned within identified jurisdictional wetlands. However, a finalized construction plan has not been provided. It should also be noted that alluvial wetlands along the fringe of the impoundments will be periodically impacted as pond levels are influenced by project operations. (**0046-9** [Perry, Robert D.])

Response: *Detailed construction plans have been requested from Duke, particularly for those activities that could potentially affect wetlands. The potential impacts to wetlands, including those that are jurisdictional, from construction and the need to obtain a Section 404 Permit from the U.S. Army Corps of Engineers will be evaluated in Chapter 4 of the EIS or as a cumulative impact as appropriate. Potential impacts to the littoral wetlands located along the margins of Make-Up Ponds A and B due to water use by the proposed two new reactors, particularly during drought periods, will be evaluated in Chapter 5 of the EIS.*

Comment: 2.4.1.3.1.1 Plants, page 2.4-16. A population of the southern adder's tongue fern (*Ophioglossum vulgatum*), a state species of concern, was identified onsite during the 2006 reconnaissance. A management plan for the southern adder's tongue fern population and any other protected plant species located within the project boundary should be provided for review by resource agencies. (**0046-10** [Perry, Robert D.])

Response: *The potential impacts of construction and operation to the population of southern adder's tongue fern (*Ophioglossum vulgatum*), a state species of concern identified in Duke's ER, will be evaluated in Chapters 4 and 5 of the EIS, respectively. If the population of this species could be affected, the possibility of development of a management plan will be addressed in the EIS. However, if there are no potential impacts to this population, the development of a management plan would be out of the scope of the NRC's review of the EIS. The DEIS will be sent to appropriate agencies for review.*

Comment: 2.4.1.3.4 Critical Species, page 2.4-20. The ER states *Because of the wide variety of ecological communities within the region, the abundance of individual species, especially plants, can vary significantly from location to location where different species serve similar ecological roles in the community. Accordingly, there is no evidence suggesting that any individual species is critical to structure or function at the ecosystem level.* It is not clear from this statement how it is concluded there are no onsite species critical to local or regional ecosystem structure or function. (**0046-11** [Perry, Robert D.])

Comment: 2.4.1.3.5 Biological Indicators, page 2.4-20. The ER indicates *there are no species at the site that might function as true bioindicators*. Again, this conclusion seems to be drawn from the assertion that species onsite are common to southeastern forests, and to the lack of population information available for the less common species allowing biologists to track future status changes. The use of a species as a biological indicator is habitat-dependent. The ER does not indicate whether or not species were evaluated by habitat type (alluvial wetland, shoreline, upland, mixed hardwood forest, etc.). As with critical species, the regional commonness of a species does not necessarily correlate to its value as a biological indicator at the habitat level.

The lack of available population information on rare species does not preclude the applicant from the need to provide information on the presence of species essential to ecosystem function or of value as a biological indicator. Indeed, the lack of information points to the need for ongoing study and monitoring of species occurrence and use of resources by habitat type, both before and after construction. (**0046-12** [Perry, Robert D.])

Response: *Sections of the ER pertaining to terrestrial ecology will be evaluated for their utility in developing the EIS and will be used accordingly. The staff will perform an independent assessment of the impacts on terrestrial species and will present their findings in Chapters 4 and 5 of the EIS.*

Comment: 10.1.1 Unavoidable Adverse Environmental Impacts of Construction, page 10.1-1. The list of hydrological and water use impacts due to construction of the facility should include wetland areas within the footprint and adjacent to the initial construction site of the Cherokee plant and the linear footage of perennial and intermittent streams that were filled and flooded for the construction of the onsite impoundments.

10.1.2 Unavoidable Adverse Environmental Impacts of Operations, page 10.1-2. The list of hydrological and water use impacts due to operation of the Lee Nuclear facility should include those imposed upon aquatic life, wetland areas and shoreline adjacent to Make-up Ponds A and B as pond levels fluctuate.

The list of ecological impacts due to operation of the Lee Nuclear facility also should include those incurred through habitat fragmentation and degradation, obstruction of migration corridors and noise and human activity.

The ER does not indicate that in-kind alternatives have been identified to mitigate for direct wetland and other natural resource impacts. In order to adequately mitigate all identified and yet-to-be-identified impacts, including the likelihood of secondary impacts, a mitigation plan should be developed for the Lee Site and facility construction/operation. Such a mitigation plan may need to encompass more than simple wetland impact mitigation or compensation. DNR will request coordinated mitigation planning and identification of the need to address future negative secondary impacts to fish and wildlife resources as well as loss of public recreational opportunities related to the Lee Nuclear facility. (**0046-27** [Perry, Robert D.])

Response: *The potential impacts to wetlands (including those around the margins of Make-Up Ponds A and B), riparian areas, streams (including shorelines), including habitat degradation and fragmentation, obstruction of migration corridors, etc. that could result from construction and operation, will be described and evaluated in Chapters 4 and 5 of the EIS. Mitigation, including the possibility of in-kind alternatives and mitigation planning, will be addressed in Chapters 4 and 5 as appropriate. Where these impacts represent unavoidable losses of natural resources, they will be summarized in Chapter 10. Impacts of the initial construction of the Cherokee plant will be addressed in the cumulative effects section of the EIS.*

D.1.2.8 Comments Concerning Ecology - Aquatic

Comment: Another problem with water discharged from nuclear plants is its temperature. This water is warmer than the water into which it is discharged, and the resulting thermal plumes cause stress to aquatic life which can include commercially important fish and shellfish. (**0001-22** [Barczak, Sara])

Comment: Another problem with water discharged from nuclear plants is its temperature. This water is warmer than the water into which it is discharged, and the resulting thermal plumes cause stress on aquatic life, which can include commercially important fish and shellfish. Warmer water temperatures proximate to a nuclear power plant result in conditions that effect the feeding and breeding patterns of various species. For instance, nuclear power plants aggravate the problem of low dissolved oxygen levels through its heated discharge to lakes and rivers. The NRC needs to study these impacts. (**0010-2, 0049-10** [Barczak, Sara])

Comment: We are particularly interested in understanding if the nuclear facilities will alter the physical, hydrologic, thermal or chemical characteristics of the Broad River in ways that might alter, prevent or delay the upstream or downstream movements of these species. The EIS should specifically address whether river water temperatures would disrupt the upstream migrations during April and May. Although the warm-water plume may not be extremely high, the difference in temperature may act as a behavioral barrier to movements. (**0037-2** [Goudreau, Chris])

Comment: Water returned to the Broad River is likely to have a substantial temperature variation from the Broad River. A sudden change is the thermal environment may be hazardous to aquatic organisms near the outflow as well as those downstream. The EIS must address these impacts and provide alternatives to eliminating or reducing aquatic thermal variations (**0045-3** [Hall, Timothy N.])

Comment: DNR has concern related to thermal impacts to all aquatic species as related to operation of the proposed Lee Nuclear facility at the thermal discharge site above the Ninety-Nine Islands dam as well as below in the Broad River (**0046-25** [Perry, Robert D.])

Response: *The NRC staff will assess potential impacts to aquatic life in the Broad River from thermal discharge of the proposed Lee units in Chapter 5 of the EIS.*

Comment: Recently, the NCWRC, along with the South Carolina Department of Natural Resources, U.S. Fish and Wildlife Service, Duke Energy, and South Carolina Electric and Gas, signed an agreement for the protection, restoration, and enhancement of diadromous fish in the Santee Basin in South Carolina and North Carolina. American shad and American eel migrations historically extended into the North Carolina portion of the Broad River sub-basin. While work will be done in other portions of the Santee Basin, the initial focus of the restoration work will occur in the Broad River sub-basin. Over time, we expect that other downstream blockages to movements of these species will be reduced or eliminated. We want to ensure that operation of the proposed Lee Nuclear site will not create any additional impediments to the upstream and downstream migrations of these species. We did not find any analyses in the Environmental Report prepared by Duke Energy regarding the potential effects on diadromous species. When diadromous species arrive at the project site in the future, monitoring should be required to make sure they are not stopped, slowed down or otherwise affected by operation of the facility. (**0037-1** [Goudreau, Chris])

Response: *Although it can recommend ecological monitoring, the NRC does not have the authority to require post-operational monitoring on the part of the applicant. However, the NRC staff will evaluate potential impacts of operation of the proposed Lee units to the aquatic environment, including potential impacts to diadromous fish species in the Broad River. The results of the analysis will be presented in Chapter 5 of the EIS.*

Comment: The potential for the cooling water intakes to impinge or entrain larval and juvenile stages of both species should also be addressed. Should South Carolina DENR not have intake specifications, we routinely recommend the use of passive screens with openings not to exceed 1 centimeter (1 millimeter in waters having anadromous fish) and with a maximum intake velocity of 0.5 feet per second. (**0037-3** [Goudreau, Chris])

Comment: One of several issues associated with a large water intake includes impingement and entrainment of aquatic organisms at the cooling water intake. Previous studies at similar nuclear sites by Duke found impingement of some fishes, mostly threadfin shad, some bluegill, and alewife, most during periods of cold water. Although these impacts may be considered small, we recommend that the licensee establish a regular monitoring program and develop a strategy to reduce impingement and entrainment, and to mitigate these potential impacts. Methods to prevent entrainment of aquatic species such as appropriate screen sizes, low pump velocities or variable operation schedules during power operations to block biotic intake must be detailed in the EIS. (**0045-4** [Hall, Timothy N.])

Response: *The applicant's proposed cooling water intake design and the potential for impingement and entrainment of aquatic organisms from operation of the proposed nuclear units will be evaluated, and the results will be presented in Chapter 5 of the EIS.*

Comment: 2.4.2.1. Aquatic Habitats, page 2.4-24. DNR disagrees with the statement that *neither the river nor Ninety-Nine Islands Reservoir is a significant aquatic habitat in a regional context*. In 1988 the South Carolina Water Resources Commission (SCWRC) prepared a Rivers Assessment (RA) of the Broad River as a part of the South Carolina Rivers Assessment initiative. The RA provides an analysis of each river in SC, based on a number of categories, including (1) Historic and Cultural, (2) Industrial, (3) Inland Fisheries, (4) Recreational Fishing, (5) Timber Management, (6) Water Supply and (7) Wildlife Habitat. Criteria for designation of the Broad River included scenic value (lack of visual obstructions by structures); absence of wastewater dischargers; outstanding fishing quality and aquatic habitat; water quality; and wildlife habitat quality. <u>The RA rated the Broad River as an outstanding river of regional significance in all of these categories</u>. (**0046-13** [Perry, Robert D.])

Response: *The comment relates to the importance of the Broad River's aquatic habitat in a regional context. The NRC staff will provide its own independent discussion of the aquatic environment in the vicinity of the proposed new nuclear units and its importance in a regional context in Chapter 2 of the EIS.*

Comment: 2.4.2.4 Mussels, page 2.4-30. The paper pond shell mussel (*Utterbackia imbecellis*) a species of state concern, occurs in Makeup Pond A. This species may be impacted by siltation, dredging and fluctuations in pond elevations due to project operations representing an adverse impact for which mitigation should be provided.
(**0046-14** [Perry, Robert D.])

Response: *The comment is related to the potential impacts of construction and operation of the proposed new nuclear units on the paper pondshell mussel (Utterbackia imbecillis), which occurs in Make-Up Pond A. Assessment of this species in addition to other aquatic organisms will be presented in Chapters 2, 4, and 5 of the EIS.*

Comment: 2.4.2.5.5. The ER states *Because the habitats of the Lee Nuclear Site are widespread within the region, the abundance of an individual aquatic species can vary significantly from location to location where different species serve similar ecological roles in the aquatic community. Accordingly, there is no evidence suggesting that any individual species is critical to structure or function at the ecosystem level*. How does this lead to the conclusion that there are no species that are critical to ecosystem structure or function at the Lee site? What specific criteria were used to evaluate individual species function by habitat type?
(**0046-15** [Perry, Robert D.])

Response: *The NRC's responsibilities under NEPA are to provide a fair and comprehensive analysis of potential impacts related to the proposed action, evaluate alternatives, and discuss potential mitigation measures as appropriate. In the Lee COL EIS, the NRC will provide an independent evaluation of the importance of various aquatic species found in the vicinity of the Lee site to ecosystem structure and function.*

Comment: We are also concerned with the fauna and aquatic fauna of this river and would ask that the thermal water aspects of this project be studied and included in the environmental impact study document. We recommend further analysis for potential impacts to the flora and fauna of the river ecosystem, especially any impacts to rare, threatened and endangered species. (**0042-4** [Crockett, Mary])

Response: *The NRC staff will assess potential impacts from thermal discharge of the proposed Lee units on aquatic biota in the Broad River. The results of the evaluation will be presented in Chapter 5 of the EIS. The NRC will also evaluate potential impacts to rare, threatened, and endangered species from construction and operation of the proposed new nuclear units. This information will be presented in Chapters 2, 4, and 5 of the EIS.*

Comment: 2.4.2.5.6 Biological Indicators, page 2.4-34. DNR agrees the primary use of an indicator is to characterize current status and track or predict significant change within a habitat or ecosystem. Therefore it is recommended there be periodic monitoring of macroinvertebrates and other sensitive aquatic species above and below the Ninety-Nine Islands dam and within onsite impoundments to track impacts of project operations to aquatic resources.

2.4.2.5.8 Other Aquatic Species of Special Interest. DNR recommends Duke conduct periodic fish surveys above and below the dam and within onsite impoundments to track impacts of project operations to aquatic resources.

NRC should be aware of a recently ratified cooperative diadromous fish passage agreement (Accord) between Duke, South Carolina Electric & Gas, DNR, North Carolina Wildlife Resources Commission and United States Fish and Wildlife Service. This agreement is intended to protect, restore and enhance diadromous fish in the Santee River Basin with particular emphasis to the Broad River sub-basin. DNR and other signatories of the Accord will require assurance construction and operation of the Lee Nuclear facility will not be an impediment to the Accord and its objectives including up and down stream migrations of diadromous fish. (**0046-16** [Perry, Robert D.])

Response: *Although it can discuss ecological monitoring, the NRC does not have the authority to require post-operational monitoring on the part of the applicant. However, the NRC staff will evaluate potential impacts of operation of the proposed Lee units to the aquatic environment, including potential impacts to diadromous fish species in the Broad River. The results of the analysis will be presented in Chapter 5 of the EIS.*

Comment: 4.3 Ecological Impacts, page 4.3-1. The fact that many of the construction impacts occurred during the construction of the Cherokee plant before construction was halted does not obviate the need to provide appropriate mitigation and compensation for these impacts. These impacts should be included in total ecological impacts due to construction of the Lee Nuclear facility. (**0046-22** [Perry, Robert D.])

Comment: 5.2 Water-Related Impacts, page 5.2-1. In response to the statement *Evaluations specific to the Lee Nuclear Site are consistent with previous conclusions: water related impacts during plant operations are SMALL and mitigation is not warranted*. DNR will evaluate future applications for Federal and state permits associated with the proposed Lee Site for impacts to aquatic resources. Avoidance and minimization of adverse impacts and mitigation and compensation for unavoidable impacts is required under Sections 401 and 404 of the US Clean Water Act. (**0046-23** [Perry, Robert D.])

Response: *The NRC's responsibilities under NEPA are to provide a fair and comprehensive analysis of potential impacts related to the proposed action, evaluate alternatives, and discuss potential mitigation measures as appropriate. Approval of other Federal and State permits associated with the proposed new nuclear units and any requirements for mitigating actions will be the responsibility of the permitting agencies. Impacts of construction of the Cherokee facility will be addressed in the cumulative effects section of the EIS.*

Comment: We understand that the volume of water taken for facilities of this type generally exceed the volume returned. Much of the water used in cooling operations will be lost through evaporation. Therefore, the EIS must analyze impacts to downstream habitats and species as a result of this water loss. We encourage you to develop an instream flow study plan that considers the potential effects of these consumptive losses across the full range of flow scenarios. How will the water abstraction impact the physical habitat of fish and other aquatic community members? We will be glad to review and participate in the development of an appropriate instream flow study to consider the potential effects on aquatic species, their habitats, and community assemblages. Please design your study to consider the potential effects to focal restoration species like American shad and American eel, rare species like the robust redhorse, and less mobile taxa such as freshwater mussels, as well as riverine guilds, and natural community assemblages (**0045-2** [Hall, Timothy N.])

Response: *The impact of water withdrawals from the Broad River for operation of the proposed new nuclear units will be evaluated and presented in Chapter 5 of the EIS.*

D.1.2.9 Comments Concerning Socioeconomics

Comment: This [William States Lee Nuclear] facility also has a significant benefit to the economy of South Carolina and Cherokee County. This multi-billion dollar investment in the county will bring over 2000 construction jobs, over 800 full time jobs during its operating life. It will contribute positively to the economy of Cherokee County and neighboring counties. The facility will also provide many high paying jobs for citizens of Cherokee County and South Carolina. (**0001-7** [Moss, Dennis Carroll])

Comment: [The Lee] facility will have a significant positive impact on the economy of Cherokee County, surrounding counties and South Carolina. The multibillion investment in Cherokee County will bring over 1000 construction jobs and over 800 high paying full time jobs during its operation. (**0001-38** [Moorhead, Gene])

Comment: I understand Lee Nuclear Station will have around the same number of employees, along with those well-paying salaries. Also, the economic impact study by the Nuclear Energy Institute tells us that over 700 of those 1000 employees will live in the same county. So the salaries stay locally. (**0001-46** [Hardy, Chris])

Comment: [T]here's going to be about 1800 to 2000 jobs during construction and probably 800 long-term. An average power plant does provide 20 to 30 million dollars of tax revenue in the state's economy, things that help schools, things that help those that need it. (**0001-78** [Blue, Lilly])

Comment: [The Spartanburg Chamber of Commerce] endorsement goes beyond the obvious economic benefits of the design, construction and operation of the Lee Station. (**0001-88** [Cordeau, David])

Comment: [M]ore than 2000 manufacturers provide jobs to tens of thousands of upstate South Carolinians. One of the principal reasons that those companies are here and continue to come here is that we have had an abundant and affordable supply of energy in this area (**0001-91** [Gossett, Lewis])

Comment: [A] lot of companies don't like to talk publicly about the fact that they could shut down and they could cost the community jobs. For a lot of those companies, they will never get to that decision because unreliable power, something they can't count on in the future, is the thing that will force them to relocate. We've seen enough of that in this region. Another reason is affordability. We do have some of the most affordable rates in the country in this area and that makes a big, big difference when companies are thinking about locating and staying here. That is one of the big cost drivers and it's something that we must maintain if we are to continue to compete with parts of the world that have other costs that are so dramatically lower than ours. (**0001-93** [Gossett, Lewis])

Comment: [I]f you realize, as we do, that there's a lot more room for growth and there's a lot more room for opportunities for this generation and for future generations, then this plant is something that you should support and you should embrace. It's exciting that they've chosen

Cherokee County, I'm glad that not only are they going to provide the jobs here, but they're going to provide the power that the jobs that will be generated as a result will need. (**0001-98** [Gossett, Lewis])

Comment: I truly understand and appreciate what this project will provide in the way of jobs for our citizens, both in the construction phase and in the operations phase. During the operations phase, we heard numbers of up to 800 workers. These employees will have competitive salaries based on their skills and training. These high wage, high skill jobs will have a profound positive impact on the per capita income of this community. (**0001-111** [Forrester, Mike])

Comment: The building of this facility will also help continue a long Duke Energy tradition of providing affordable energy rates for business and industry. (**0001-112** [Forrester, Mike])

Comment: Today seven nuclear reactors at four sites generate 52 percent of South Carolina's electricity. I ask the regulators to consider how these communities have been changed by the presence of those facilities. I believe you'll find that these communities have enjoyed increased economic output, improved community infrastructure and a peace of mind garnered from years of nothing but positive actions from their corporate neighbors. (**0001-150** [Murphy, William])

Comment: The Spartanburg Chamber believes that this facility will also benefit the economy of the Upstate and of South Carolina. The potential investment in the region will have considerable impact, not only in Cherokee County, but in neighboring Counties like Spartanburg. Development of the Lee Station in the Upstate will bring thousands of construction jobs, additional services, and hundreds of high paying, full-time jobs during the actual operation of the plant. There is no doubt that the project will make a major contribution to the economy of Cherokee County, Spartanburg County and neighboring counties in the region. (**0011-4** [Cordeau, David])

Comment: The Lee Nuclear Station will provide significant benefits to South Carolina's economy and has broad support from citizens within the community who stand to directly benefit from the construction and operation of this facility. Duke Energy's multi-billion dollar investment in South Carolina will bring more than 3,000 construction jobs and over 800 full-time jobs, contributing positively to the economy of Cherokee County, as well as neighboring counties, during its operating life. Additionally, as we have seen at other facilities, station employees will contribute to their communities in many ways, including financially and through volunteer and service commitments. (**0013-2** [Barrett, J. Gresham] [Brown, Henry E.] [Clyburn, James E.] [DeMint, Jim] [Graham, Lindsey] [Inglis, Bob] [Spratt, John M.] [Wilson, Joe])

Comment: This facility also has a significant benefit to the economy of South Carolina and Cherokee County. This multi-billion dollar investment in the County will bring over 2000 construction jobs and over 800 full-time jobs during its operating life. It will contribute positively to the economy of Cherokee County and neighboring counties. The facility will also provide needed high paying jobs for the Citizens of Cherokee County and of South Carolina. (**0016-3** [Cook, Jim])

Comment: During construction, thousands of workers with different skills will be required. Operations at the Lee Station could employ approximately 1,000 workers. These employees will have competitive salaries based on their skills and training. I can attest to the positive economic development impact that the Oconee Nuclear Station has had in Oconee and Pickens Counties. I am absolutely sure that the addition of Lee Nuclear Station to Cherokee County will stimulate economic development in the entire region, in both direct spending and in economic activity generated by the plant and its employees. (**0018-4** [Sandifer, Bill])

Comment: The addition of Lee Nuclear to Cherokee County will support economic development. Nuclear plants substantially contribute to local and state economies, both directly and indirectly. (**0023-2** [Peeler, Harvey S.])

Comment: The proposed facility disclosed to Cherokee County by Duke Energy will have a significant benefit to the economy of Cherokee County and South Carolina. (**0024-2** [Batchler James D.; Foster, Rufus H.; Humphries, H. Baily; Little, Quay; Mathis, Charles; Parris, Hoke; Spencer, Tim])

Comment: Access to affordable, reliable energy is a critical factor in attracting future business investment and maintaining our state's healthy economy. Without new capacity to produce more energy, South Carolina's economic growth potential could be jeopardized as business and industry choose to halt expansion plans or invest elsewhere. Beyond supporting current economic activity and future development, the Lee Nuclear Station will, itself create thousands of new jobs during construction and could generate more than 1,000 high-paying jobs once the facility is operational. (**0030-3** [Taylor, Joe])

Comment: This facility is also a benefit to the economy of South Carolina. This several billion dollar investment in South Carolina will bring over 2000 construction jobs and over 800 full-time jobs during its operating life. It will also contribute positively to the economy of Cherokee County and neighboring counties over its lifetime. (**0047-3** [Vogel, Chip])

Comment: The economies of both counties have been under attack over the last decade with the loss of a tremendous number of textile and industrial jobs. Most of these jobs have been outsourced overseas, and we are fighting a battle to replace the jobs and the investment. One of the key attractions to our area are competitive electrical rates, the availability of power and the existence of excess capacity in our system grid. Adding the Lee Nuclear Plant to this grid is key to our being competitive in this world economy. (**0048-1** [Chapman, A. Foster])

Response: *These comments generally express support for the proposed action based on the potential positive socioeconomic impacts it would be expected to bring to the region. Socioeconomic impacts of construction and operation will be addressed in Chapters 4 and 5 of the EIS.*

Comment: We have hundreds and hundreds of empty factories and empty warehouses throughout South Carolina and North Carolina due to textile industries and furniture industries leaving this area. We have thousands and thousands of workers that would love to be building solar panels and wind turbines that are now being produced in other countries by the thousands. We are losing this economic battle and we're going to end up in a situation where the 800 jobs Duke says are going to be at the nuclear plant -- which by the way, I contest. From what I understand, it will probably be more like 200 permanent jobs, it's not worth it. (**0001-36** [Cherin, Mike])

Comment: The next issue is jobs. This is a major federal activity and I'll go back to this, but this is now federal dollars being spent, not just the industry's money. This is major federal actions that Congress is spending taxpayers' money on. By my calculations, this evening we heard that it was going to be 800 permanent jobs. If there's a cut-rate deal on the AP1000 and Duke gets one for $8 billion --that's for one unit, so I'm assuming the 800 jobs is for two units, so that would be 1600, so double my number because it comes out to $800 million a job and you double that, 16? No, even higher, I can't do the math in my head. So how much money per job are we talking about here? It's astronomical. We need to look at the relative ability to create jobs from other possible energy sources. And I commend to you a report by the Tennessee Valley Authority, because TVA has generating capacity in solar, in wind, in hydro, in coal, in gas and in nuclear. And in fact, if you look at their studies, you will find that you will get more jobs per kilowatt-hour and offer more cost effective electricity for the consumer in every other form of power generation. Nuclear has the least jobs per kilowatt-hour. Please include and reference the TVA document in your EIS. (**0001-51** [Olson, Mary])

Comment: Energy was cheap when all the jobs left, when our country decided to do this free trade, gobblization as a friend of mine renamed it, NAFTA stuff. That's where all the jobs went. They didn't go because of energy cost. Cheap energy isn't going to bring the jobs back. (**0001-179** [Minerd, Leslie])

Comment: The enticement of jobs is false hope for people in this area. Everyone knows that trained people will be brought in from the outside to work the facility just like BMW, TNS Mills. (**0026-3** [Poole, Mary Jane])

Response: *Socioeconomic impacts, such as labor impacts associated with the construction and operation of the Lee Nuclear Station, will be addressed in Chapters 4 and 5 of the EIS.*

Comment: Duke Power depreciated the Catawba nuclear facility off the tax books at the end of 30 years, which was supposed to be the life of the plant. The NRC, however, chose to relicense this plant. But York County taxes did not return to the original income for this facility. Therefore, we are exposed to the risk but do not now reap the benefits of tax revenue from this plant. We will also be left with the eternal legacy of the site after closure.
(**0001-193** [Connolly, Mary Ellen])

Response: *The NRC is not involved in establishing energy policy; rather, it regulates the nuclear industry to protect public health and safety within existing policy. Issues related to taxes are outside of the NRC's mission and authority and are not addressed in the EIS. The socioeconomic impacts will be addressed in Chapters 4 and 5 of the EIS.*

Comment: The question is, you know, what's a fair balance between having this water that's lost to generate nuclear energy and the loss to those that need to generate renewable hydro-generation, hydroenergy. And there's not a good answer to that, but there's a few ways -- I guess the concern that I've got is that somehow mitigation needs to be taken into account in this environmental effort, the review that's about to take place. There's several different ways to fix the problem and strike a fair balance. I'm not proposing any particular one or promoting any particular one. There may be a way to create a rain catchment area so that makeup water can be put back into the river as it's lost through evaporation. Alternatively, it may be possible to have deep well pumping to do the same function. That's not necessarily a great solution either. I don't know if there is a great solution. At the very least, you know, if this site is going to be built and what basically is free fuel to those hydro-generators downstream is lost, then perhaps some kind of straight-forward financial reimbursement would be the best way to go. (**0001-101** [Stone, Bryan])

Response: *This comment expresses concern regarding the availability of an adequate supply of water in the area to support both the two new reactors and any downstream hydro plants. This topic will be addressed in Chapter 5 of the EIS.*

Comment: We are also concerned with possible economic or cumulative affects growth and/or development to the currently rural areas of the county and around the river this project may bring. This project may cause further development around the river in the form of housing subdivisions and infrastructure which may impact the scenic viewshed and environmental health of the river. We ask that you study these impacts and include them in your document.
(**0042-5** [Crockett, Mary])

Response: *The EIS will include an evaluation of the socioeconomic and environmental impacts of operating a nuclear plant at the Lee site on the region. The evaluation will include both aesthetic and housing impacts.*

D.1.2.10 Comments Concerning Historic and Cultural Resources

Comment: I'm sure the Cherokee Indians may have an interest in what's going on with this river because much of their history is there. (**0001-195** [Connolly, Mary Ellen])

Response: *The NRC has initiated consultation with the Eastern Band of the Cherokee Indians in accordance with Section 106 of the National Historic Preservation Act of 1966 and NEPA and will continue to do so throughout the EIS process.*

Comment: We have been in informal comments with Duke Energy and the NRC on this project for the past year, and we have reviewed and commented on several cultural resources surveys conducted to identify potential historic properties at the Lee Nuclear Plant site. Based on our conversations and the review of these documents, it is the opinion of our office that a programmatic agreement or some other type of formal agreement may be the best way to handle historic properties and cultural resources at the Lee Nuclear Plant site.

We understand that not all aspects of the construction and operation of the plant will be finalized at the time of the granting of the license. In our opinion, the agreement should include:

- The survey and historic property identification within additional Areas of Potential Effect (APE) as identified for discharge structures, transmission lines, roads, etc.
- Management of the property as well as future construction over the 40 year term of the license
- The handling of late discoveries and future consultation (**0043-1** [Dobrasko, Rebekah])

Comment: There was some question about the State Historic Preservation Office's (SHPO) recommendation for a programmatic agreement to cover future work/potential effects at the site. Our recommendation is based on 36 CFR 800 Protection of Historic Properties. Based on 36 CFR 800.14 (b)(1), the regulations specify that a programmatic agreement may be used when: Effects on historic properties cannot be fully determined prior to the approval of an undertaking and when nonfederal parties are delegated major decision-making responsibilities. Since the discharge structures, transmission lines, roads, etc. related to the construction of the Lee Nuclear Plant are not yet defined, and most likely will not be defined prior to the issuance of a COL, then it is the SHPO's opinion that any effects to historic properties cannot be determined prior to the undertaking. Also, Duke Energy will be responsible for the surveying and reporting aspects of this project, so in our opinion, a programmatic agreement between the NRC, the SHPO, Duke Energy, and any other interested parties, such as any Native American tribes, may be appropriate in this case. (**0044-1** [Dobrasko, Rebekah])

Response: *The NRC intends to work with the SHPO on the request to formalize an agreement on future activities, but at this time the exact mechanism for this agreement is still being discussed.*

D.1.2.11 Comments Concerning Health - Radiological

Comment: How can these proposed reactors assure safeguard against emissions which were previously considered too minute to cause cancer? (**0001-143** [Patrie, Dr. Lew])

Comment: All nuclear power plants leak and emit toxins and nuclear cancer-causing pollutants into the air, water and the soil. (**0001-196** [Connolly, Mary Ellen])

Comment: I am concerned about radioactive emissions. (**0005-3** [Craig, Anne])

Comment: Tritium has been linked to developmental problems, cancers, genetic defects, miscarriages and damage to fetuses even at low levels. What is the NRC's specific dose estimates for tritium (radioactive hydrogen and Nobel gases for all metropolitan areas within 100 miles (INCLUDING MY GRANDCHILDREN!). (**0007-8** [Arnason, Deb])

Comment: Tritium like Duke leaked. Anyone done an independent study of leukemia in the area of Duke leak? Charlotte Observer, Thurs. Oct 11, 2007. Near my Grandchildren on well water!! (**0008-4** [Arnason, Deb])

Comment: Air quality: Please supply specific dose estimates for tritium and Nobel gases for all metropoilitan [metropolitan] areas within 100 miles. (**0034-2** [Karpen, Leah R.])

Comment: What are the specific dose estimates including tritium and Nobel gases for all areas within 100 miles? (**0038-2** [Turk, Lawrence "Butch"])

Response: *Emission estimates will be based on the approved AP1000 Design Control Document (Westinghouse 2008); these emission estimates are anticipated to be conservative (that is, they will overestimate emissions). The human health and environmental impacts of the emissions will be addressed in Chapter 5 of the EIS.*

Comment: Duke alone already operates five reactors in South Carolina and several more nearby in North Carolina. Further, a host of nuclear waste and nuclear industrial operations are here in South Carolina. The Savannah River Site near Aiken is the most radioactive Department of Energy site in the nation. The Barnwell nuclear dump is also a radioactive hot spot. And nowhere in the application does it discuss the cumulative impacts of having all these facilities operating in South Carolina. It does not discuss the cumulative health impacts to Carolinians. The NRC must address these cumulative impacts to human health in the draft EIS. (**0001-23** [Barczak, Sara])

Comment: The first is the Part 20 radiation standards that are the federal government's protection to the populations that are impacted by these activities that do release radioactivity into the air, into the water, generate waste and sewage, radioactive sewage, and the allied activities that support the facility also have all these emissions. I'm deeply concerned that this area is already impacted by nine nuclear power plants and two more being added will make eleven and I know that every piece of data that you will hand me says that the operations are below the Part 20 standards. You need to look at the fact that you allow those levels. If those levels are allowed, can that kind of activity meet your standards -- being the federal regulators that I'm speaking to. So it's not only this community, there's Charlotte, there's Columbia and we have to consider the Savannah River Site in that calculation. (**0001-50** [Olson, Mary])

Comment: As the NRC is aware, Duke already operates five reactors here in SC and several more nearby in NC. Further, a host of nuclear waste and nuclear industrial operations are here in SC. The Savannah River Site near Aiken is the most radioactive Department of Energy site in the nation. The Barnwell nuclear dump is also a radioactive hot spot. Nowhere in the application does it discuss the cumulative impacts of having all these facilities operating in SC. Nor does it discuss the cumulative health impacts to Carolinians. The NRC must address these cumulative impacts to human health in the draft EIS. (**0010-3, 0049-11** [Barczak, Sara])

Comment: We have enough nuclear power plants and problems that go along with it, i.e. Barnwell Dumpsite, Savanah River Plant. (**0026-2** [Poole, Mary Jane])

Response: *Impacts of the normal operation of the two new reactors will be addressed in Chapter 5 of the EIS, and cumulative impacts addressed in the cumulative effects section of the EIS.*

Comment: Duke says substance found at the site contained radioactive tritium leaking into the groundwater from the Catawba nuclear power plant on Lake Wylie. Well, this is near my grandchildren. And one of the things I've learned with tritium -- I didn't know anything about it -- by the way, my grandchildren have well water. (**0001-66** [Arnason, Deb])

Comment: I wanted to see what tritium does to cancer. Tritium is commonly found in water molecules. New evidence of an association between increased cancers and proximity to nuclear facilities raises difficult questions. Should pregnant women and young children be advised to move away from them, should local residents check the safety of their gardens and crucially, should those around the world who are planning to build more reactors think again. (**0001-70** [Arnason, Deb])

Comment: Harmful radioactive pollution is released into the air and water from nuclear power plants on a routine basis. Also, highly toxic radioactive waste is stored on site in pools of water. "Children living near nuclear power plants suffer higher levels of birth defects, cancer and early death. A study of medical records found that **infant death rates near five U.S. nuclear plants increased within two years after the plants opened. The study also found that infant deaths decreased 15-20% soon after the reactors closed**. And the decreases in cancer and birth defects continued for 7 years after plant closure. (Environmental Epidemiology and Toxicology, 2002, Radiation and Public Health Project)" (**0035-2** [Hamrick, Mike])

Response: *The comments concern emissions of tritium and health effects that may result from such emissions. Emission estimates will be based on the approved AP1000 Design Control Document; these emission estimates are anticipated to be conservative. The NRC will evaluate human health and environmental impacts of the emissions in the EIS. Analysis results will be presented in Chapter 5 of the EIS.*

Comment: What kind of harm might we expect from a nuclear power plant in Cherokee County? One study compared cancer deaths before and after an operating plant in Burke County, Georgia. Cancers in all populations rose 24.2 percent in the county where the reactor began operating. Meanwhile, cancer rates statewide, all of Georgia, fell 1.4 percent. Can we say it came only from the nuclear reactor? Let's look at the radioactivity in the drinking water downstream from that Vogtle reactor. Between 1990 and 2003, an increase of 17 percent of beta radiation was detected by the Jasper water treatment plant, 112 miles downstream. Cesium 137 increased by 37 percent in that period after the Vogtle Nuclear Plant began operating. The Georgia Environmental Protection Division tested water, sediment, fish and found that indeed radiation was from two to 50 times above background levels -- two to 50 times above background levels. Is this from the bomb plant which is nearby? No. We have Savannah River Company separated out, the tritium, the radioactive water, from those two sources was tested and found 1900 curies going into the river in 2003, 1200 curies of radiation in 2004, 1860 curies of radiation in 2005. (**0001-30** [Zeller, Lou])

Comment: We have now from the University of South Carolina in Charleston, an analysis of 17 research papers covering 136 nuclear sites in the UK, Canada, France, the US, Germany, Japan and Spain, the incidence of leukemia in children under nine living close to the site showed an increase of 14 to 21 percent while it could be as high as 24 percent, depending on how close they were to the nuclear facility. Okay, this was followed by a German study of 14 cases of leukemia compared to the accepted four cases. And here's another one, this is in Germany, the results were published in the International Journal of Cancer. The main findings were a 60 percent increase in solid cancers and 117 percent increase in leukemia among young children living near all 16 large Germany nuclear facilities between 1980 and 2003. The closer they lived to the plant, the worse the health problems. Twice as likely to contract cancer as those living further away. (**0001-67** [Arnason, Deb])

Comment: Another example [of misleading information] is a cancer rate study that I keep hearing cited. It's been scientifically debunked and rejected by numerous state and federal review boards. But I keep hearing that cited. (**0001-84** [James, Andrew])

Comment: [R]ecent findings suggest that children living near nuclear reactor facilities face an increased risk of cancer A study of medical records found that infant death rates near five U.S. nuclear plants increased within two years after the plants opened. The study also found that infant deaths decreased 15 to 20 percent soon after the reactors closed. And decreases in cancer and birth defects continued for seven years after plant closure. Last year, researchers at the Medical University of South Carolina, already cited this evening, analyzed research regarding 136 nuclear sites in half a dozen states (sic) including the United States, and they reported leukemia incidences and deaths among children, depending on the closeness that they had to the nuclear facilities. Other studies found that children living closer to nuclear plants were more than twice as likely to contract cancer as those living further away, which has been confirmed by the German government. Critics of these studies again asserted that the radiation doses from nuclear power plants were too low to cause cancer, but other new data assert that there is no safe level of radiation, that infants and children are at greater risk than the standard man about whom safety standards have been calculated since the day the first bomb was dropped on Hiroshima.

Difficult questions come with this new evidence of a connection between increased cancers and proximity to nuclear facilities, such as how do you advise pregnant women and families with young children, and what do you advise people about the safety of crops grown in proximity to nuclear reactors? (**0001-141** [Patrie, Dr. Lew])

Comment: What about the health of my precious grandchildren? I understand there is a book out now that proves children are getting sick in the vicinity of nuclear plants, something in the title about radioactive materials in their baby teeth! (**0007-4** [Arnason, Deb])

Comment: Contrary to assertions about the safety of nuclear power and that no adverse health risks arise from people living in proximity to nuclear reactors, recent findings suggest that children living near nuclear facilities face an increased risk of cancer. Though a link had long been suspected, but never proved, that seems likely to change.

A study of medical records found that infant death rates near five U.S. nuclear plants increased within two years after the plants opened. The study also found that infant deaths decreased 15-20% soon after the reactors closed. And the decreases in cancer and birth defects continued for 7 years after plant closure. (Environmental Epidemiology and Toxicology, 2002, Radiation and Public Health Project). Last year researchers at the Medical Univ. of South Carolina analyzed research regarding 136 nuclear sites in the UK, Canada, France, Germany, Japan, Spain and the United States, reported increased leukemia incidences and deaths among children, depending on their closeness to the nuclear facilities (European Journal of Cancer Care, vol 16, p 355). Other-studies found that children living within 5 kilometers of the plants were more than twice as likely to contract cancer as those living further away, a finding that has been accepted by the German government. Critics of these studies again asserted that the radiation doses from nuclear power plants were too low to cause cancer, but other new data assert that there is no safe level of radiation, that infants and children are at greater risk than the standard man about whom safety standards have been calculated since the Hiroshima bomb.

Difficult questions come with this new evidence of a connection between increased cancers and proximity to nuclear facilities, such as how to advise pregnant women and families with young children, and the safety of crops grown in proximity to nuclear reactors. (**0015-4** [Patrie, Dr. Lew])

Response: *These comments refer to health impacts, which will be addressed in Chapters 4 and 5 of the EIS.*

D.1.2.12 Comments Concerning Accidents - Severe

Comment: There is a shocking NRC document called Report on Spent Fuel Accident Risk. According to the NRC, fire in a spent fuel pools at a reactor like Yankee which stores 488 metric tons of spent fuel would cause 25,000 fatalities over a distance of 500 miles if evacuation was 95 percent effective, but that evacuation rate would be almost impossible to achieve. (**0001-43** [Biggs, Diane])

Comment: Are you aware of the Sandia study NUREG-1738? (**0041-7** [Sutlock, Dot])

Comment: Are you aware of the claims that a spent fuel fire could produce 30,000 uninhabitable square miles which in this case would include Charlotte and the nearer smaller cities? Read [the article] What about the Spent Fuel? Bulletin of the Atomic Scientist Jan/Feb 2002. (**0041-8** [Sutlock, Dot])

Response: *These comments address large consequences of very low probability events at reactors being decommissioned. The NRC has adopted the use of mean risk estimates for the purposes of implementing its safety goal policy (51 FR 30028). Risk is the product of the event probability and consequences. When the consequences cited in the comments are multiplied by the probability of the events leading to the consequence, the average individual and population risks associated with the spent fuel pools are lower than the risks established in the safety goal policy. In fact, the first conclusion of NUREG-1738 (NRC 2001) is as follows: "The risk at decommissioning plants is low and well with[in] the Commission's safety goals. The risk is low because of the very low likelihood of a zirconium fire even though the consequences from a zirconium fire could be serious." Designs of spent fuel pools for new reactors have benefitted from risk analyses of spent fuel pools for existing reactors. Thus, the staff expects that the risks associated with spent fuel pools for new reactors will be lower than those associated with spent fuel pools at reactors undergoing decommissioning.*

Comment: Are you aware that the Sandia CRAC-2 study projects 42,000 early fatalities from an accident at Catawba and 26,000 cancer deaths from an accident at McGuire? (**0041-9** [Sutlock, Dot])

Response: *The potential consequence of a severe accident can be large. However, not all severe accidents lead to large consequences, and the probability of a severe accident is* *extremely low. As a result, risk, which is the product of probability times consequence, is the measure used to evaluate impacts of severe accidents. Risk and environmental impacts of postulated accidents at the Lee site will be assessed, and analysis results will be presented in Chapter 5 of the EIS.*

D.1.2.13 Comments Concerning the Uranium Fuel Cycle

Comment: Another part of this equation is the fact that we have no place to put nuclear waste. We have the hubris to believe that as humans we can tell future generations for 120,000 years that this waste that we put on their shoulders is a responsible act. It's not a responsible act. Nevada is refusing to take nuclear waste, most South Carolinians, when they find out about what's going on down in Aiken with the nuclear waste repository planned there, do not want to see this. (**0001-35** [Cherin, Mike])

Comment: What are you going to do with nuclear waste. (**0001-108** [Moss, Charles])

Comment: [T]he environmental impact statement should look at the complete nuclear fuel cycle and impacts all along the chain. (**0001-133** [Clements, Tom])

Comment: [L]ow level nuclear waste is produced all the time -- there is no place that high level nuclear waste, spent fuel rods that are taken out of the reactors, is going at the current time. The Yucca Mountain facility -- and I want to make this clear to everybody -- construction has stopped. And what might those alternatives to Yucca Mountain be? [Senator Pete Domenici] is talking about creating interim storage sites, one in the east and one in the west or the reprocessing of spent fuel which, as was also pointed out, if that program goes forth, a huge amount of spent fuel would go to wherever the reprocessing site would be. And unfortunately the Savannah River Site is a prime candidate for that in the United States.

So what does that mean for the Lee site? And this has to be analyzed in the environmental impact statement. There is likely no place that that spent fuel is going to go. So we may well be looking at the de facto high level waste dump on the banks of the Broad River. (**0001-134** [Clements, Tom])

Comment: I think the spent fuel should be a show stopper. There's no place for it to go, there's nothing to do with it. (**0001-135** [Clements, Tom])

Comment: I'm concerned about the production of the nuclear reactors from the uranium mining right through the time we're dealing with nuclear waste, which are very high level kinds of waste, and the health effects generated from them. (**0001-138** [Patrie, Dr. Lew])

Comment: I would urge the NRC to maybe start looking inside themselves, maybe start looking at their hearts and start realizing that we're really messing with something here that is mostly interfered by with something that I call WMD, which is waste management denial. (**0001-180** [Sorensen, Ole])

Comment: [H]ow does it affect the next generation when we have nowhere to put the waste. (**0001-186** [Sorensen, Laura])

Comment: It doesn't take just five years for this to be decontaminated once it's buried. It takes 10,000 years. (**0001-187** [Sorensen, Laura])

Comment: Duke has no place to put the spent fuel rods that they use except in huge pools within the Catawba plant itself, as well as McGuire and Oconee plants. Nor is there any repository or any hope for one, it looks at this point, for the rods that will be produced in the future. What are we going to do with these rods that are now stored on these plants? Even the low level waste may have no place to go if the low level dump at Barnwell closes. (**0001-191** [Connolly, Mary Ellen])

Comment: The NRC needs to look at the environmental impact of the entire nuclear generated fuel cycle, from the uranium mining to the post production of nuclear energy. The environmental impact on areas of our southwest, particularly on Native American lands, has been devastating. Health risks associated with uranium mining should also be considered. (**0005-1** [Craig, Anne])

Comment: I am concerned that there is no present solution for safe storage of the radioactive waste. It seems ludicrous to pour billions of dollars into building power plants whose life span is 25-30 years, leaving our children and grandchildren with lethal waste for thousands of years. There are safer and better ways to meet our energy needs. (**0005-5** [Craig, Anne])

Comment: Where will the waste that remains hazardous for thousands of years be stored? (**0007-6** [Arnason, Deb])

Comment: No one agency has yet solved the problem of safe disposal of nuclear waste, or spent nuclear fuel. Better not to create waste in the first instance. (**0034-6** [Karpen, Leah R.])

Comment: Where will the waste go? (**0041-2** [Sutlock, Dot])

Response: *The impact of the uranium fuel cycle, including disposal of low-level radioactive waste and spent fuel, will be addressed in Chapter 6 of the EIS. The generic impacts of the fuel cycle are codified in 10 CFR 51.51(b), Table S–3, "Table of Uranium Fuel Cycle Environmental Data." Per the guidance in 10 CFR 51.51 and Section 5.7 of NUREG-1555 (NRC 2000), the staff will rely on Table S–3 as a basis for uranium fuel-cycle impacts.*

The safety and environmental effects of long-term storage of spent fuel on site has been evaluated by the NRC and, as set forth in the Waste Confidence Rule at 10 CFR 51.23, the NRC generically determined that "if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite of offsite independent spent fuel installations. Further, the Commission believes there is reasonable assurance that at least one mined geologic repository will be available within the first quarter of the twenty-first century and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level waste and spent fuel originating in any such reactor and generated up to that time."

Comment: In January, Russia and the U.S. Commerce Secretary signed a trade agreement. This allowed Russia to incrementally boost enriched uranium exports to the U.S. The deal allows the sale of Russian enriched uranium directly to U.S. utilities. By 2014, one in five American nuclear plants will be running on Russian uranium. According to the U.S. Nuclear Energy Institute, the American market will have a uranium shortage beginning in 2011. I would like maybe us to start to think about the future and what's happened to us with oil. Everyone is complaining that we need to be sustainable at home, we need to not be dependent on oil. And yet what we're setting our future for with uranium imports from Russia and other countries, Australia and Kazakhstan, we're going to be dependent on uranium imports.
(**0001-181** [Sorensen, Laura])

Comment: I am coming with a very simple message and that is that there is no reasonable likelihood that when these nuclear reactors are built there will be fuel supply to run them. It's not the case, as was just suggested, that demand exceeded supply recently. That happened back in 1990. Since then, the shortfall has been made up by the supplies from Russians. The International Atomic Energy Association projection puts the Russian source of uranium running out in 2014, the enrichment uranium running out in 2011 and the stockpiled uranium running out -- guess when -- 2008. If this is the case, why are we building new ones? I suggest that in this part of the study, you look very carefully at the supply question, globally.
(**0001-188** [Sticpewich, John])

Comment: I tend to wonder why where uranium production is such a question, we're talking about new reactors. And until then, I suggest we should stop wasting the taxpayers' money talking about things that really can't happen. (**0001-189** [Sticpewich, John])

Response: *The irretrievable and irreversible commitment of resources, such as uranium, will be addressed in the context of the resources' availability in Chapter 11 of the EIS.*

Comment: Back from the '50s to the '70s, a lot of people were killed because of uranium poisoning. They were open pit mining. The United States ended up giving the Native

Americans compensation for the medical bills for cancer. This is a proven fact, uranium mining equals cancer. (**0001-183** [Sorensen, Laura])

Comment: [R]ight now uranium has more than tripled in price, so the government is going back now and these mining companies are going and saying we're coming back and we have this new technology. It's also called uranium leaching, it's leach mining. And what they do is they inject chemicals into the ground and that leaches up off the rock, the uranium. So they did studies of course and told these Native Americans in New Mexico and the four corner states of the west that this was okay, this is safe, this is brand new technology. Well, the Native Americans, after they've lost their families to cancer, are saying no way. We're going to have other experts come in and do a study and see how safe this is. So two other companies came in and they said, listen, if they do this, within seven years, you water supply will be destroyed. (**0001-184** [Sorensen, Laura])

Comment: So I think I am asking you all to think globally when there's an issue like this. It's not just about us right here. I hope that you can think about the [Native Americans] and think about this whole process of not just flipping your switch or having this right here in your area. How does it affect the rest of the world, how does it affect Native Americans and their children? (**0001-185** [Sorensen, Laura])

Response: *The impact of the uranium fuel cycle will be addressed in Chapter 6 of the EIS. The generic impacts of the fuel cycle are codified in 10 CFR 51.51(b), Table S–3, "Table of Uranium Fuel Cycle Environmental Data." Per the guidance in 10 CFR 51.51 and Section 5.7 of NUREG-1555 (NRC 2000), the staff will rely on Table S–3 as a basis for uranium fuel-cycle impacts.*

D.1.2.14 Comments Concerning Transportation

Comment: Let's talk about nuclear waste and let's talk about the accidents that are going to happen with nuclear waste -- not if, but when. The more nuclear waste and the more nuclear products that are transported throughout this country, we're going to have trucks going off the road, spilling nuclear waste. (**0001-34** [Cherin, Mike])

Comment: I am concerned about the transport of high level radioactive materials over our roads and rails, the likelihood of accident and the lack of adequate emergency response (**0005-4** [Craig, Anne])

Response: *The health and safety impacts of transporting fuel and waste by truck to and from the proposed Lee site will be addressed in Chapter 6 of the EIS.*

Comment: And I see truncation under NEPA, particularly because there is clear evidence that one of the requirements for these projects to go forward is at least the appearance of a solution

to the nuclear waste problem, which would involve moving the nuclear waste, which would most likely involve moving the nuclear waste somewhere into South Carolina, either Barnwell or Savannah River Site. That's conjecture -- it is -- but there's these federal EIS's about to come out on it. So how and why do these all fit together and in what way is the public, and more importantly, our environment, served by these separate, broken up, scatter-shot analyses that will result in nobody looking at the impact of tens of thousands of shipments of high level nuclear waste traveling through downtown Charlotte, around the beltway of Columbia, potentially across the bridge in downtown Asheville, definitely through the heart of Atlanta, definitely through the heart of Augusta. And where is that going to be looked at?
(**0001-57** [Olson, Mary])

Comment: You're going to tell me that that [transporting nuclear waste from multiple power plants] through the Carolinas doesn't fit in this EIS. Well, you tell me which EIS it fits in.
(**0001-58** [Olson, Mary])

Response: *The health and safety impacts of transporting fuel and waste to and from the proposed Lee site will be addressed in Chapter 6 of the EIS. The transportation of nuclear waste and fuel to and from other reactors is outside the scope of this review.*

Comment: Disposal of hazardous waste material from the Lee site must be carefully reviewed. Potential hazards during waste removal and transport to an appropriate facility must be documented in the EIS. (**0045-13** [Hall, Timothy N.])

Response: *The impacts from the generation, handling, and disposal of hazardous waste material from the operation of the Lee site will be addressed in Chapter 5 of the EIS.*

Comment: [W]e have a traffic advisory committee, which includes local residents, evaluating potential traffic impacts to the community during construction and operation, and we are working with neighbors and businesses regarding transmission and railroad right of ways.
(**0012-3** [Dolan, Bryan])

Response: *Environmental impacts associated with any planned new transmission lines and additional railroad rights-of-way will be addressed in the context of cumulative effects, as well as potential impacts associated with upgrades to the existing lines. The nonradiological impacts of transporting construction materials and workers will be addressed in the EIS.*

D.1.2.15 Comments Concerning Cumulative Impacts

Comment: I don't think it is fair to have two here. The adverse impact on one is enough for taxpayers to deal with, what with the, increased cancer incidents in Oconee.
(**0004-1** [Kohler, Elizabeth])

Comment: Construction of the Lee site, or any of the other alternatives considered, may foster or accelerate increased development of the surrounding areas. The EIS should model potential changes including, but not limited to, demographics, population growth, traffic needs, and spread of invasive and exotic species. Particular attention should be given to the effected riverine and natural wetland and floodplain systems. We are concerned that the water intake from the Broad River could disrupt the ecological balance within the system. How will the water intake affect the drinking water supplies and assimilative capacity of the Broad River? (**0045-11** [Hall, Timothy N.])

Response: *The direct and indirect impacts associated with the construction and operation of the proposed Lee site will be evaluated in Chapters 4 and 5 of the EIS. The impacts from multiple nuclear units will be discussed in the cumulative section of the EIS to the extent the staff has determined it is appropriate.*

D.1.2.16 Comments Concerning the Need for Power

Comment: As a high growth state, South Carolina needs additional safe and reliable sources of baseload electric generation. (**0001-1** [Moss, Dennis Carroll])

Comment: In the Carolinas, Duke Energy adds approximately 40,000 to 60,000 customers each year. As a regulated utility, it's our obligation to serve that growth in electric demand. Each year, Duke Energy uses an integrated planning approach to ensure it can reliably and economically meet the electric needs of our customers well into the future. The planning process takes into consideration many factors, including projected electricity use, existing generation, generation supply contracts, demand-side management, energy efficiency and potential new sources of generation such as renewable resources, coal, natural gas and nuclear. Duke's planning process tells us that among other options such as renewables, coal and natural gas, it is prudent to maintain new nuclear as an option for our customers going forward. Although we have not yet made a decision to build a new nuclear plant, if we are to maintain nuclear as an option for our customers in the latter part of the next decade, it is important that we prudently plan for this option now. (**0001-12** [Dolan, Bryan])

Comment: I also come today to applaud the company's efforts to anticipate growing needs and plan now for what we need in the future. We need safe, reliable electricity for my family and customers across the Carolinas. (**0001-74** [Blue, Lilly])

Comment: Demand across South Carolina is growing and recently a group of utility executives met ... [and] were talking about if we didn't make the decisions right now to build these plants within the next 10 to 12 years, that we could expect, particularly in the southeast -- and this was the phrase that they used -- sustainable and uncontrolled blackouts. So demand is growing. We need additional capacity. There are really no reasonable alternatives to new nuclear plant construction. Without new capacity, our factories risk shutdowns or closure (**0001-92** [Gossett, Lewis])

Comment: As our area continues to grow, the need for additional safe, reliable and affordable electric generation will increase greatly. This facility will provide that additional needed baseload capacity while also reducing greenhouse emissions. (**0001-113** [Forrester, Mike])

Comment: South Carolina needs additional safe, reliable, base-load electric generation, which does not emit greenhouse gases to serve our growing needs (Duke Energy alone is adding 40,000 - 60,000 new customers each year). Electric generation from renewable energy is important. However, these resources cannot provide the sustained capacity that base load generators, like nuclear, can provide 24-hours a day (**0018-2** [Sandifer, Bill])

Comment: U.S. Department of Energy estimates that our electricity demand will increase 25 percent by 2030. It's easy to see why. As technology advances, our economy expands, and our population increases, so too will our need for energy grow. We have so many devices that require electricity to recharge-such as laptops, cell phones, and iPods. And in the not too distant future we may be driving cars powered by fuel cells that will also be plugged in for recharging. (**0029-2** [Houston, Kate])

Comment: The two proposed nuclear generators at the Lee Nuclear Station would supply energy to about 2 million homes, with a capacity of 2,234 megawatts. Duke Energy now serves 2.3 million customers in both North and South Carolina. The company adds about 50,000 new customers each year to its services in both states, and expects to increase output by 10,700 megawatts by 2027 in order to meet demand.

South Carolina has witnessed phenomenal growth in the past few years. In 2007, our state was the 10th fastest growing state in the nation, according to the U.S. Census Bureau. Estimates show this trend continuing in the decades ahead and more sources of power will be needed to accommodate this demand. (**0030-2** [Taylor, Joe])

Response: *Affected states or regions may prepare a need for power evaluation and an assessment of the regional power system for planning or regulatory purposes. A need for power analysis may also be prepared by a regulated utility company and submitted to a regulatory authority such as a state Public Utilities Commission (PUC), who has regulatory authority over the Certificate of Public Necessity and Convenience, as well as rates and rate recovery. However, the data may be supplemented by information from other sources as required. The determination for the need for power is not under NRC's regulatory purview. When another agency has the regulatory authority over an issue, NRC defers to that agency's decision. The NRC staff will review the need for power and determine if it is (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting* *uncertainty. If the need for power evaluation is found to be acceptable, no additional independent NRC review is needed. The need for power will be addressed in Chapter 8 of the EIS.*

Comment: The NRC also needs to fully evaluate Duke's need for power along with alternative supply options, including energy efficiency and demand-side management measures. We are concerned that Duke is over-estimating capacity needs and that the NRC needs to fully evaluate whether the additional generating capacity is truly needed. The high cost of nuclear power plants will likely result in cost overruns and rate increases and this is not mentioned in the application. (**0001-15** [Barczak, Sara])

Comment: The other part of this too is the Cliffside, the coal burning power plant that Duke is working so hard to complete right now, is only 35 miles away from where we are here. How can they justify that the power needs for this region need an 880 megahertz coal burning power plant and two nuclear reactors? It's ridiculous. Even Duke admits that we don't need new power plants until 2020. We can do the smart thing with alternative energy, provide jobs and keep the health of this region intact. (**0001-37** [Cherin, Mike])

Comment: A major reason that we're discussing new generation nuclear plants is the need for new baseload electric generation. The DOE projects a drastic growth in energy demand and the southeast is arguably the fastest growing region in the United States. Certainly conservation and efficiency are the lowest hanging fruit and must be pursued vigorously. (**0001-81** [James, Andrew])

Comment: The U.S. Census Bureau projects that by 2030, North and South Carolina will increase in population by 52 and 28 percent respectively. Energy conservation is and will continue to be an important contributor in alleviating increase in energy demand due to the growing population. However, I would caution that the environmental impact statement provide realistic and achievable estimates as to how much energy savings can be realized without decreasing our overall standards of living. (**0001-124** [Chisolm, Sarah])

Comment: NRC needs to fully evaluate Duke's need for power along with alternative supply options, including energy efficiency and demand side management measures. We are concerned that Duke is overestimating capacity needs and the NRC needs to fully evaluate whether the additional generating capacity is truly needed. The NRC needs to include all of Duke's new power plant proposals, such as the new coal unit proposed for the Cliffside plant in NC. (**0009-4, 0049-4** [Barczak, Sara])

Comment: In the Carolinas, Duke Energy has been adding approximately 40,000-60,000 customers each year. As a regulated utility, Duke Energy has an obligation to serve this growth in demand for electricity. Each year, Duke Energy Carolinas uses an integrated planning approach to ensure it can reliably and economically meet the electric energy needs of our customers well into the future. The planning process takes into consideration many factors, including projected electricity use, existing generation, generation supply contracts, demand-side management, energy efficiency initiatives, and potential new sources of generation such as renewable resources, coal, natural gas and nuclear. (**0012-2** [Dolan, Bryan])

Comment: If energy efficiency is delivered to Duke customers to reduce consumption across the service area by 30%, would this new power plant be needed? How many other generation sources could be scrapped? (**0038-5** [Turk, Lawrence "Butch"])

Response: *Affected states or regions may prepare a need for power evaluation and assessment of the regional power system for planning or regulatory purposes. In North and South Carolina, the need for power analysis may also be prepared by a regulated utility company and submitted to a regulatory authority, such as a state PUC. This analysis by the regulated utility company, called the Integrated Resource Plan (IRP), contains details on energy efficiency, demand side management, and peak-power reduction strategies, all of which are considered conservation activities. These data may be supplemented by information from other sources as required. The state PUC also has regulatory authority over issuance of the Certificate of Public Necessity and Convenience, as well as rates and rate recovery regarding the construction and operation of new power plants. Duke submitted the IRP to both North and South Carolina in 2007 and accounted for the Cliffside Station in out-year capacity and margin projections. The determination for the need for power is not under NRC's regulatory purview. When another agency has the regulatory authority over an issue, the NRC defers to that agency's decision. The NRC staff will review the need for power and determine if it is (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. If the need for power evaluation is found to be acceptable, no additional independent NRC review is needed. Alternative energy supply options will be further evaluated and addressed in Chapter 9 of the EIS. The information provided in these comments will be considered to determine whether it significantly affects the forecast upon which the applicant relied for its need for power analysis.*

Comment: This electric generation facility will contribute significantly to meeting the growing energy needs in South Carolina. At the same time, it is believed nuclear energy has a small carbon footprint and contributes to the United States quest to reduce carbon emissions and other air pollutants. (**0024-1** [Batchler, James D.] [Foster, Rufus H.] [Humphries, H. Baily] [Little, Quay] [Mathis, Charles] [Parris, Hoke] [Spencer, Tim])

Response: *The need for power based on population growth and electrical demand in the Carolinas will be analyzed and addressed in Chapter 8 of the EIS. Alternative energy sources will be reviewed and addressed in Chapter 9. Relative impacts on the environment, including air quality impacts from plant emissions (e.g., criteria pollutants and greenhouse gasses), will be* *evaluated and compared with alternative energy sources. Both North and South Carolina participate in Federal, State, and regional programs designed to mitigate and reduce emissions.*

D.1.2.17 Comments Concerning Alternatives - Energy

Comment: And cloudy Germany is now switching to solar energy. They've found ways to do that, and I'd like to see the Carolinas do that. (**0001-68** [Arnason, Deb])

Comment: An engineer on [an educational TV] program, he went on to say if we would go to the desert in Nevada where the government owns millions of acres and we were to take 100,000 acres of that desert and cover it in solar panels, that that alone would meet the energy of the United States currently and into the next 10 or 20 years. We could manufacture the panels here. Now my question is -- now this was on PBS -- why don't we do that? It's clean (**0001-107** [Moss, Charles])

Comment: [I] understand cloudy Germany is now using solar energy. (**0008-1** [Arnason, Deb])

Response: *Alternative energy sources, including solar, will be evaluated and addressed in Chapter 9 of the EIS.*

Comment: [W]e know that wind, solar and particularly bio are just not reasonable alternatives for us in terms of meeting our capacity. Sure you can power one plant here and there and maybe a neighborhood, but you can't meet the needs that we're going to have. And in fact, biofuel, we are certainly learning at this time, may in fact be one of the most detrimental things to our environment we've seen in a long time. (**0001-96** [Gossett, Lewis])

Comment: I strongly urge the regulators to consider the consequences of not employing the proposed action. It is estimated that the nation's demand for electricity will increase by nearly 50 percent by 2030. Without an increase in baseload nuclear generation, I believe the EIS would conclude that the only realistic alternatives would be those which would emit substantial quantities of carbon dioxide. Nuclear power, while not part of the group, ranks among the lowest life cycle emitters in bulk power generation. (**0001-149** [Murphy, William])

Response: *These comments generally express support for the proposed nuclear power plant as a baseload source of power in Duke's region of interest but do not provide specific information related to environmental impacts of the proposed project. Alternative energy sources (including renewables such as wind, solar, and biomass) and the no-action alternative will be evaluated in terms of the proposed project in Chapter 9 of the EIS.*

Comment: I stand here against this thing because, number one, it's unnecessary. There are other ways to generate electricity besides nuclear. (**0001-103** [Moss, Charles])

Response: *The EIS will be prepared in accordance with 10 CFR 51.75(c). Alternative energy sources, including renewable energy sources (as well as energy conservation and efficiency programs) and the no-action alternative will be addressed in Chapter 9 of the EIS and will be assessed against the proposed project. Energy conservation will also be considered as part of the need for power analysis in the EIS.*

Comment: [O]ur nation and our planet faces a crisis of rapidly expanding proportions with respect to global warming, increasing acidity of our oceans due to absorption of carbon dioxide, air pollution and its horrendous health effects, and dependency on unstable regions of the world for most of our energy needs. (**0001-159** [Wolfe, Clinton])

Response: *The NRC is not involved in establishing energy policy; rather, it regulates the nuclear industry to protect public health and safety within existing policy. The discussion of alternative energy sources in Chapter 9 of the EIS will describe potential impacts from alternative energy sources, including fossil and renewable energy sources such as wind and solar, in comparison with the proposed action. Nuclear power plants do not burn fossil fuels and therefore do not generate or emit criteria pollutants or greenhouse gases.*

Comment: The [Lee] application does not adequately address these other energy options. Renewable energy technologies, which are not likely to be targeted by terrorists nor have the capacity, in terms of accidents, to kill thousands of people or permanently contaminate large land areas, should not be ignored by Duke. Energy efficiency measures also pose no health or safety risks to the public and Duke has significant resources to tap in this arena. Duke has excellent wind resources within its service area and should invest more in developing this clean, safe energy resource instead of spending billions of dollars on the proposed Lee site. There is also potential for bioenergy production in their service territory. Clean forms of bioenergy represent a home-grown energy source that can provide local jobs to rural areas and also support farmers and the region's economy while helping expand clean energy technologies. The use of solar and other clean energy choices were summarily dismissed in the application. The draft EIS must include a more thorough analysis. (**0001-14** [Barczak, Sara])

Comment: Nuclear energy appears to be riskier than some of the other alternatives that have been presented here tonight. (**0001-144** [Patrie, Dr. Lew])

Comment: Solar does not represent this [tritium dose] hazard, or many others. (**0008-2** [Arnason, Deb])

Comment: [T]he Lee application does not adequately address these other energy options. Renewable energy technologies, like bioenergy, solar, and wind, which are not likely to be targeted by terrorists nor have the capacity, in terms of accidents, to kill thousands of people or permanently contaminate large land areas, should not be ignored by Duke. Energy efficiency measures also pose no health or safety risks to the public and Duke has significant resources to tap in this arena. (**0009-2, 0049-2** [Barczak, Sara])

Comment: Duke has excellent wind resources within its service area and should be encouraged to invest more in developing this clean, safe energy resource instead of spending billions of dollars on the proposed Lee site. There is also potential for bioenergy production in their service territory. Clean forms of bioenergy represent a 'homegrown' energy source that can provide local jobs to rural areas that would also support farmers and the region's economy, while helping expand clean energy technologies. The use of solar technologies and other clean energy choices were summarily dismissed in the application. The draft EIS must include a more thorough analysis of energy alternatives. (**0009-3** [Barczak, Sara])

Comment: Duke has excellent wind resources within its service area and should be encouraged to invest more in developing this clean, safe energy resource instead of spending billions of dollars on the proposed Lee site. There is also potential for bioenergy production in their service territory. Clean forms of bioenergy represent a 'homegrown' energy source that can provide local jobs to rural areas that would also support farmers and the region's economy, while helping expand clean energy technologies. The use of solar technologies and other clean energy choices were summarily dismissed in the application energy alternatives. (**0049-3** [Barczak, Sara])

Response: *The NRC is not involved in establishing energy policy; rather, it regulates the nuclear industry to protect public health and safety within existing policy. The discussion of alternative energy sources, including wind, solar, and biomass, will be addressed in Chapter 9 of the EIS, which will compare and describe potential environmental impacts from alternative energy sources. Energy risk evaluation is not within the scope of the EIS in accordance with NEPA requirements. As part of the COL process and in conjunction with the EIS, the NRC staff will conduct a safety review detailing site-specific safety analysis and design specific analysis.*

Comment: We have, as scientists claim, ten years -- ten years -- to change our ways. And these new nuclear reactors won't come on line in time to fix the problem. South Carolina is the third least efficient state in the country when it comes to energy consumption. We need to start implementing energy efficiency. We could start using renewables. I hear that wind doesn't have maybe the most promising future in South Carolina but we're also the 13th sunniest state in the country and the sun isn't unreliable. So it hurts me to stand here in South Carolina and know that there's so many new proposed nuclear reactors because this state has so much potential. We have innovation, technology and potential on our side. I just ask you to take that into consideration in the environmental impact statement. (**0001-119** [Tansey, Sara])

Comment: [I]f we can improve the structure of our buildings to reduce their consumption by 50 percent, that's just another way we're going to save energy and we really don't need any more nuclear plants. (**0001-156** [Saye, Jack])

Comment: [Dependence on foreign uranium] doesn't seem very promising when we have so many resources here with wind. (**0001-182** [Sorensen, Laura])

Comment: You want to do something, then build a few windmills. They will provide free clean energy and will also employ people to build them. We have plenty of places to install them and the benefits of windmills would greatly outweigh those of another power plant. (**0004-2** [Kohler, Elizabeth])

Comment: I would like to stress the more commonsensical arguments against such an unsafe, expensive and environmentally unsound method of producing energy. First of all, why don't we emphasize our country going on an energy diet? Before we consider new sources of megawatts, we should consider cultivating negawatts. We need to first of all clean up all the slop in the system before we search for new energy sources of any kind but especially those that are basically unsafe and expensive. (**0006-2** [Craig, Thomas])

Comment: Please insist that Duke Energy check out all sorts of renewable energy options at www.renewableenergyworld.com. A free subscription is available at www.rew-subscribe.com. We want to know how much wind energy capacity exists within the Duke service area? What is the solar capacity of all rooftops within the Duke service area? (**0007-13** [Arnason, Deb])

Comment: The most rapid and inexpensive method of dealing with shortage of electrical energy is through energy efficiency, which would be feasible if citizens' groups, industry, financial interests and government would immediately and vigorously and begin action as if our way of life depended upon it.

Truly renewable energy source should likewise be pursued. Wind power is already less costly than nuclear power, and the cost of solar energy is somewhat more expensive-today but costs are coming down rapidly. Nuclear power plants may become economically obsolete before new ones could be brought on line. Solar and wind power do not need water, which we all know is an important issue in the southeastern U.S. The notion that renewable energy cannot supply the electricity requirements of the United States has been widely put forward without careful technical evaluation. Several sources suggest just the opposite. Nuclear energy appears to be the riskier course. (**0015-6** [Patrie, Dr. Lew])

Comment: Could Duke energy instead promote solar capacity and/or supply wind energy? Are there other sources of power possible? (**0034-4** [Karpen, Leah R.])

Comment: I would like to see everyone convert to wind or solar power sources. The government should give power company's tax breaks for converting over to wind or solar power. (**0036-2** [Thomas, Amber])

Comment: As a prospective downwinder, I am horrified by this scheme. Nuclear energy is not the solution to the climate crisis -- it takes too long, costs too much and still has enormous health, safety and security challenges -- and therefore is an enormous distraction from the REAL solutions of massive, systemic, delivered and installed energy efficiency and really clean power from the natural forces of wind, sun and the appropriate harnessing of water power. (**0038-1** [Turk, Lawrence "Butch"])

Comment: How much wind energy capacity exists within the Duke service area? What is the solar capacity of all the roof tops within the Duke Service area? (**0038-4** [Turk, Lawrence "Butch"])

Comment: Why take any risk or make any assumptions when there are so many green options for reducing energy consumption. Americans have become energy hogs. We need to take responsibility and not throw everything onto future generations to deal with. (**0039-2** [Hedges, Jean])

Comment: Support green technology. It may be different in every area: geothermal one place, solar another, windmills, or a combination. Short run costs=long term savings and safety. Instead of having taxpayers fund billions for unsafe technology give them direct incentives to use all of the thousands of safe alternatives that are readily available. (**0039-4** [Hedges, Jean])

Comment: Are you aware that Americans use 340 million BTU per person per year and Europeans use less than 150 million BTU per person per year? Efficiency improvements would eliminate the need for new power plants entirely. Are you aware of the recent developments in geothermal electricity, wave energy, wind, off-shore wind, micro-wind, PV, building integrated PV, solar thermal, concentrated PV, Stirling dishes, fuel cells, algae, ...? (**0041-6** [Sutlock, Dot])

Response: *The NRC does not establish public policy regarding electric power supply or energy-consuming alternatives, nor does the NRC promote the use of nuclear power as a preferred energy alternative. In addition, the NRC does not regulate alternatives or activities to producing electricity that do not involve nuclear power. The NRC does evaluate energy alternatives (including conservation) as part of its review of applications for new nuclear power plants in accordance with NEPA requirements. The comparative review of energy alternatives such as wind, solar, biomass, and geothermal alternatives and their associated environmental impacts will be addressed in Chapter 9 of the EIS.*

D.1.2.18 Comments Concerning Alternatives - System Design

Comment: 2.2.1.2 The Vicinity, page 2.2-4. The proposed height of the reactor domes (185.5 ft above ground level) will be visible from Kings Mountain State Park, Croft State Park and Crowder's Mountain State Park, and from the downstream reach of the Broad River designated as a State Scenic River. Cooling towers are planned to be *shorter and compact*, but may still be tall (> 90 ft) relative to the local area. These construction features represent a visual impact to the view shed including important recreational, scenic and natural conservation areas. (**0046-1** [Perry, Robert D.])

Response: *Aesthetic impacts of the cooling towers will be addressed in Chapter 5 of the EIS.*

D.1.2.19 Comments Concerning Alternatives - Sites

Comment: Regarding the National Environmental Policy Act, I would add this for the Nuclear Regulatory Commission staff, the Environmental Policy Act requires a comparison of alternative sites for nuclear power reactors as well as others. Within the NRC's own records, LBP079, Judge Carlin in the Atomic Safety Licensing Board, wrote how and where NRC staff utterly failed to properly do what the law requires. It is up to the Nuclear Regulatory Commission staff to do the job to protect public health and safety, not to simply ditto what industry hands to them on the platter. (**0001-32** [Zeller, Lou])

Response: *The Council on Environmental Quality advises that when there are potentially a very large number of alternatives, only a reasonable number of examples covering the full spectrum of alternatives must be analyzed and compared in an EIS (46 FR 18027). The NRC staff will review the alternative site-selection process to determine if it is systematic, employs reasonable selection criteria, and constitutes an acceptable number of reasonable sites for consideration. The process must enable the applicant and reviewers to evaluate and select proposed and alternate sites based on environmental preference and obvious superiority. The process and results will be provided in Chapter 9 of the EIS.*

Comment: The three alternate sites to be evaluated in the EIS (Anderson and Oconee Counties, SC, and Davie County, NC) should also present a similarly extensive review of impacts to protected species. The [U.S. Fish and Wildlife] Service has previously submitted a list of T&E for the South Carolina counties to be considered in the EIS. (**0045-6** [Hall, Timothy N.])

Response: *The NRC will enter into informal consultation with the FWS to obtain the most recent information on Federally listed species in counties affected by the project. A reconnaissance-level description and evaluation of potential impacts to Federal and State-listed species at the three alternative sites will be provided in Chapter 9 of the EIS. The NRC's NUREG-1555 (NRC 2000) specifies a reconnaissance level of information and analysis for alternative sites, whereas a more in-depth level of information and analysis of potential impacts to protected species are required for the proposed Lee site.*

D.1.2.20 Comments Concerning Benefit-Cost Balance

Comment: [T]he question that you have to ask yourself is you don't like nuclear, why would they build nuclear. Why? Well, if they build renewable energy generation exclusively or mostly, the price of power would go up dramatically. You take people that can't afford food right now, they can't afford their energy right now. Cost is a big concern to a lot of people and to, you know, in a short-term manner, raise the price of power by 50 percent, 100 percent because it's important to build renewable as quick as possible, that's just not do-able for a lot of people. (**0001-102** [Stone, Bryan])

Response: *The benefit-cost balance for the project will rely on the best available estimate of project timing and duration, with uncertainties noted. Chapter 11 of the EIS will discuss the estimated overall costs and environmental impacts of the proposed project. The discussion of alternative energy sources in Chapter 9 of the EIS will describe potential impacts from these sources in comparison with the proposed action.*

Comment: The EIS scope should also include the impact on public well-being resulting from the risk of money being taken from the public in the form of taxes with loan guarantees being paid out to Duke investors and people who are loaning. (**0001-201** [Rudolf, Jerry])

Comment: Why should you allow taxpayer dollars to subsidize an obsolete technology? Why should taxpayer dollars subsidize obsolete and dangerous nuclear reactors when they are so unnecessary? (**0041-4** [Sutlock, Dot])

Response: *The NRC is not involved in establishing energy policy; rather, it regulates the nuclear industry to protect public health and safety within existing policy. Issues related to the subsidization of nuclear power are outside the scope of the NRC's mission and authority and will not be addressed in the EIS.*

Comment: And how does it [nuclear power] stack with the price of fuel going up and up and up while other technologies like solar are coming down and down and down in price. (**0001-55** [Olson, Mary])

Comment: Nuclear is largely scalable, very low emission, reliable in all weather types and most importantly, safe. With respect to the environment, it also has the smallest geographic footprint when stated on a kilowatt-hour basis than most other forms of generation, including renewables. (**0001-82** [James, Andrew])

Comment: We understand and we know that the facts that you've heard about the cost of the generation of nuclear power being low are accurate. And quite frankly, I haven't seen any evidence to indicate that these other alternative sources are getting that much cheaper and they're actually realistic in South Carolina, particularly wind. (**0001-94** [Gossett, Lewis])

Comment: I stand here against this thing because there are other ways to generate electricity besides nuclear. And the astronomical expense of this thing. (**0001-104** [Moss, Charles])

Comment: How much would each option cost compared to the proposed nuke? What are the true costs of nuclear reactor operation - including all the costs born by we taxpayers including direct subsidies, tax credits, loan guarantees, federal waste program, federal insurance program and costs born by victims including health impacts from routine release of radioactivity, miming [mining], processing nuclear fuel, waste transport, management, treatment (including incineration and heat treatment) and disposal? (**0038-6** [Turk, Lawrence "Butch"])

Comment: At least a quarter of the country is in the Sunbelt. Once upon a time we gave tax incentives to folks who installed solar panels. It is absurd that we would rather spend billions on new nuclear generators than give away thousands on tax incentives to common folks!!!!!!!!!! Pay them enough and they will install!!!!!!!!!!!!!!!!! (**0039-3** [Hedges, Jean])

Response: *These comments discuss in part the cost effectiveness of nuclear power relative to alternative power sources. The NRC does not promote the use of nuclear power as a preferred energy alternative, and it does not regulate energy alternatives that do not involve nuclear power. The NRC does, however, evaluate energy alternatives as part of its review under NEPA for applications of new nuclear power plants. The discussion of alternative energy sources in Chapter 9 of the EIS will describe potential impacts from these sources in comparison with the proposed action. A discussion of the costs of the proposed projects will be provided in Chapter 11 of the EIS. Because the NRC is not involved in establishing energy policy but rather, in regulating the nuclear industry to protect the public health and safety within existing policy, issues related to the subsidization/tax incentives of nuclear power are outside the scope of the NRC's mission and authority and will not be addressed in the EIS. The environmental and health risks (both long- and short-term) of both constructing and operating two new reactors on the Lee site will be addressed in Chapters 4 and 5 of the EIS. In addition, the environmental and health impacts from the nuclear fuel cycle, related transportation impacts, and decommissioning of the nuclear facility will be addressed in Chapter 6 of the EIS. The overall environmental and health costs of the proposed project, as well as the expected benefits, will be summarized in Chapter 11 of the EIS.*

Comment: Whereas anxiety about global climate change and a growing energy shortage is leading to calls for more nuclear power plants, often overlooked are facts that nuclear power is massively expensive and risky. Without federal subsidies and incentives, including liability insurance, risk insurance for delays, production tax credits and loan guarantees totaling billions of dollars, Duke would not and could not consider construction of these 2 proposed reactors. Furthermore, during such proposed construction, rate payers would be expected to pay in advance, even if such facilities were never completed. While projected construction costs continue to rise, already each proposed new reactor will likely cost at least 6 billion dollars. (**0015-1** [Patrie, Dr. Lew])

Response: *The NRC is not involved in establishing energy policy; rather, it regulates the nuclear industry to protect public health and safety within existing policy. Issues related to the subsidization and incentives of nuclear power are outside of the NRC's mission and authority and will not be addressed in the EIS. The purpose of the EIS is to disclose potential* *environmental impacts of building and operating the proposed nuclear power plant. The determination for the impact of building and operating a nuclear power plant on retail power rates is not under NRC's regulatory purview. However, Chapter 11 of the EIS will address the estimated overall costs and environmental impacts of the proposed project.*

Comment: Estimates of the cost of nuclear power plants vary by billions. Cost overruns are usual. Is a nuclear power plant a wise investment? And who will pay? Should our Federal government pay for such endeavors--at taxpayer expense, of course? Can we vote on it (**0034-5** [Karpen, Leah R.])

Response: *This comment expresses concern regarding the cost of building nuclear power plants. The applicant, Duke, is responsible for all costs incurred in constructing the Lee Nuclear Station. Because the NRC is not involved in establishing energy policy but rather, in regulating the nuclear industry to protect public health and safety within existing policy, issues related to the subsidization of nuclear power are outside of the NRC's mission and authority and will not be addressed in the EIS. The benefit-cost balance for the project will rely on the best available estimate of project timing and duration, with uncertainties noted. Chapter 11 of the EIS will address the estimated overall costs and environmental impacts of the proposed project.*

Comment: The planning for the new reactors, including the Westinghouse AP1000 design, has skyrocketed. Florida utilities pursuing the same design have estimated the cost of $6-8.5 billion for one reactor. That's tripling the cost from just one year ago. And a few days ago, a Charlotte Observer article reported that Duke conceded that its original cost estimate of $6 billion is out of date. (**0001-16** [Barczak, Sara])

Comment: Nuclear power is the lowest cost producer of baseload electricity. The average production cost is $1.76 per kilowatt-hour and that's including the cost of operating and maintaining the plant, purchasing the fuel and paying for management of used fuel. (**0001-77** [Blue, Lilly])

Comment: The overnight cost of these plants, six to nine billion dollars, what about the many years that the plants are going to take to build? I heard someone mention $20 billion. We have no idea. But I'll tell you, I really am offended by Duke because they say in the fact sheet that nuclear power is economical but where's the cost of the thing? We are intervening before the Public Service Commission against so-called pre-construction costs for these units. And Duke is fighting tooth and nail not to reveal the costs. The South Carolina legislature basically allowed pre-construction costs last year, but we feel that the public, we have a right to know what we're going to be paying for these things in South Carolina or in any other state. (**0001-136** [Clements, Tom])

Comment: [T]he Duke site that's being looked at, there was about $500 million spent out there to build reactors in the 1980s and they turned that into a film studio where the Abyss was filmed.

And I have a great fear we're going into another abyss. Massive pre-construction costs are going to be pumped into the site, the ratepayers are going to be saddled with it and then I'd like to see what local people are going to be saying about the economic benefits while the South Carolina legislature has guaranteed that you're going to have to pay for something that you never get. (**0001-137** [Clements, Tom])

Comment: Duke Power acknowledged that the cost of this energy future for them may embody as much as 120 percent increase in existing electric rates. And yet as the previous speaker spoke, Duke Power Company absolutely refuses to disclose the cost estimates to the consumer for the Lee project, as well as the cost that it projects for the alternatives, most obviously the alternative of increased energy efficiency. I charge NRC with responsibility of forcing Duke to be forthcoming in those costs and to include all of them in your environmental analysis. The environmental costs have been well addressed by others and I won't repeat them, but we know the costs are there, cost of nuclear waste, the risk of accidents, the impacts to the water resources of the Broad River. (**0001-172** [Guild, Bob])

Comment: Why are the true costs of all associated activities not being factored into Duke's projections? (**0007-14** [Arnason, Deb])

Comment: The high cost of nuclear power plants will likely lead to cost overruns and rate increases; this is not mentioned in the application. The price for new reactors, such as Westinghouse's AP1000 design that TVA intends to use, has skyrocketed. Utilities in Florida pursuing the same reactor design have recently stated costs of $6 to $8.5 billion per reactor, nearly tripling their estimates from just one year ago. Just a few days ago, a Charlotte Business Journal article reported that Duke conceded that its original cost estimate of $6 billion is out of date. (**0009-5, 0049-5** [Barczak, Sara])

Comment: It was also recently decided by the NC Utilities Commission that Duke's updated cost estimates are trade secret and don't need to be made public. Does the NRC have access to these 'secret' 'costs? If so, how will the public know that the NRC compared the most current costs of the proposed new nuclear plant appropriately when comparing to other energy sources or energy efficiency measures? If the NRC is not able to see these 'secret' cost figures, how can the NRC appropriately determine that building new reactors is the right decision? (**0009-6** [Barczak, Sara])

Comment: Nuclear power is expensive. Duke is reluctant to publish financial data, but experts say that nuclear reactors today cost between 6 and 9 billion dollars each to construct. Duke plans two. (**0035-3** [Hamrick, Mike])

Response: *The benefit-cost balance for the project will rely on the best available estimate of project timing and duration, with uncertainties noted. Chapter 11 of the EIS will discuss the estimated overall costs and environmental impacts of the proposed project.*

Comment: The EIS also should include the cost for the cradle to grave responsibility for waste, impacts of that waste on the health and economic welfare of the public for waste throughout the process it goes through. This process should include any reprocessing that's done, any subsequent processing until this waste reaches its final resting place. There's no reason why the nuclear industry, if it is as safe as they say, should not itself be responsible for this waste from cradle to grave. And I ask that that cost be included in the EIS scope. (**0001-200** [Rudolf, Jerry])

Response: *The NRC is not involved in establishing energy policy; rather, it regulates the nuclear industry to protect public health and safety within existing policy. The impacts of the nuclear fuel cycle will be addressed in Chapter 6 of the EIS. The environmental and health risks (both long- and short-term) of both constructing and operating two new reactors on the Lee Nuclear Station site will be addressed in Chapters 4 and 5 of the EIS. The overall environmental and health costs of the proposed project, as well as the expected benefits, will be summarized in Chapter 11 of the EIS.*

Comment: Is it worth the money that everybody's talking about, the billions of dollars, billions of dollars, to provide these jobs for people that their family is going to be affected further down the road, cancer and all kind of disease, whatever, is going to come into the water and the chemicals and whatever. A lot of families live on the Broad down there where this nuclear site is at and everybody down there eats the fish, they swim in the river and play in the river. It's like a livelihood to them. And y'all change everybody's livelihood. (**0001-121** (Blackwood, Andy))

Comment: NRC has an obligation under the National Environmental Policy Act to fully consider without prejudice or preconceptions the holistic cost to the human and natural environment of this proposed action, the Lee Nuclear Station, as compared to the alternatives and benefits. (**0001-170** [Guild, Bob])

Response: *The environmental and health risks (both long- and short-term) of both constructing and operating two new reactors on the Lee site will be addressed in Chapters 4 and 5 of the EIS. The discussion of alternative energy sources in Chapter 9 of the EIS will describe potential impacts from these sources in comparison with the proposed action. The overall environmental and health costs of the proposed project, as well as the expected benefits, will be summarized in Chapter 11 of the EIS.*

Comment: North and South Carolina both currently enjoy low electricity prices, a substantial part of which is due to the efficiencies and cost-effectiveness of operating our current nuclear power plants. Upfront construction costs for nuclear power plants are large but the operating life span and low operating cost of nuclear power plants must also be factored in.

I ask that the environmental impact statement take a comprehensive look at lifetime costs of building and operating the proposed new nuclear plants. And additionally, a comparison of lifetime costs of any alternatives. I believe that nuclear will be competitive with the alternatives. (**0001-123** [Chisolm, Sarah])

Response: *This comment discusses the cost effectiveness of nuclear power relative to alternative power sources. The NRC does evaluate energy alternatives in applications for new nuclear power plants as part of its review in accordance with NEPA requirements. The discussion of alternative energy sources in Chapter 9 of the EIS will describe potential impacts from these sources in comparison with the proposed action. A discussion of the costs of the proposed projects will be included in Chapter 11 of the EIS.*

Comment: The EIS should include the cost to the public for the public assumption of risk. The Price-Anderson Act caps the Duke Power financial risk for catastrophic events and the rest of that risk goes to the public. The cost of this risk can be calculated using standard methods like the insurance industry uses. These costs would include things like the health impacts, cost of care and compensation, probably the impact on business and the economy in the world. (**0001-199** [Rudolf, Jerry])

Response: *The NRC is not involved in establishing energy policy; rather, it regulates the nuclear industry to protect public health and safety within existing policy. Thus, matters related to the Price-Anderson Act of 1957 are outside the scope of this review and will not be included in the EIS. However, the EIS will include an evaluation of potential health impacts of operating a nuclear plant on the Lee site in Chapter 5. In addition, the safety assessment for the proposed licensing action was provided as part of the application. The NRC is in the process of developing a SER that analyzes all aspects of construction and operational safety. The NRC will only issue a license if it can conclude that there is reasonable assurance that: (1) the activities authorized by the license can be conducted without endangering public health and safety, and (2) such activities will be conducted in compliance with the rules and regulations of the NRC.*

D.2 The Supplemental Scoping Process

The supplemental public scoping meeting regarding Make-Up Pond C was held on June 17, 2010, at the Restoration Church International in Gaffney, South Carolina. The meeting summary and meeting transcript are available electronically in the NRC Public Document Room or from ADAMS at accession numbers ML101800406 and ML101760446, respectively.

D.2.1 Overview of the Scoping Processes

At the Gaffney meeting, 34 attendees provided oral or written comments that were recorded and transcribed by a certified court reporter. In addition to the oral comments and written statements submitted at the public meetings, the NRC received 17 emails and 6 letters containing comments during the supplemental scoping period. At the conclusion of the supplemental scoping period, the NRC staff reviewed the scoping meeting transcript and all written material received during the comment period and identified individual comments. These comments were organized according to topic within the proposed EIS or according to the general topic, if outside the scope of the EIS. Once comments were grouped according to subject area, the staff determined the appropriate response for the comment.

The comments from the supplemental scoping period and their responses were published in the *Environmental Impact Statement Supplemental Scoping Process Regarding Make-Up Pond C Summary Report, William States Lee III Nuclear Station Units 1 and 2 Combined Licenses, Cherokee County, South Carolina* (ML103220015). To maintain consistency with the Scoping Summary Report, the correspondence ID number along with the name of the commenter used in that report is retained in this appendix.

Table D-3 identifies in alphabetical order the individuals who provided comments during the supplemental scoping period, their affiliations, if given, and the ADAMS accession number that can be used to locate the correspondence. Although all commenters are listed, the comments presented in this appendix are limited to those within the scope of the environmental review.

Table D-3. Individuals Providing Comments During Supplemental Scoping Comment Period

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
Arnason, Deb		Letter (ML101740338)	0010
		Meeting Transcript (ML101760446)	0001-6
Barczak, Sara	Southern Alliance for Clean Energy	Letter (ML101900426)	0030
Barnett, Barbara A.	Four Seasons Sierra Committee of Henderson Co. NC	Email (ML101750764)	0021
	League of Women Voters of Henderson Co., NC	Email (ML101750764)	0021
		Meeting Transcript (ML101760446)	Comments the same as Correspondence ID #0021
Bliss, Rachel		Letter (ML101740335)	0009
		Meeting Transcript (ML101760446)	0001-20

Table D-3. (contd)

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
Boger, Paul	Greater York Chamber of Commerce	Meeting Transcript (ML101760446)	0001-13
Breckheimer, Steve		Email (ML102290307)	0037
Brooks, Tim	Nestle Prepared Foods	Meeting Transcript (ML101760446)	0001-8
Clements, Tom	Friends of the Earth	Email (ML092680877)	0002
		Meeting Transcript (ML101760446)	0001-31
Cook, Jim	Cherokee County Development Board	Meeting Transcript (ML101760446)	0001-26
Corbett, Susan	Chair, South Carolina Sierra Club	Meeting Transcript (ML101760446)	0001-30
Craig, Anne		Letter (ML101740334)	0008
		Meeting Transcript (ML101760446)	Comments the same as Correspondence ID #0008
Cross, John	URS JSCC Project	Email (ML101740616)	0026
Dolan, Bryan	Duke	Meeting Transcript (ML101760446)	0001-5
Drake, Joan W.		Email (ML101760352)	0023
Fair, Gabriel	Students for Environmental Action	Meeting Transcript (ML101760446)	0001-22
Forrester, Mike	State Representative District 34	Meeting Transcript (ML101760446)	0001-3
Gregg, Ben	South Carolina Wildlife Federation	Letter (ML101820646)	0032
Haire, Wenonah G.	Catawba Indian Nation	Letter (ML102110494)	0039
Hale, Kendall		Email (ML101720639)	0003
Hallock, Judith		Letter (ML102030057)	0034
Hancock, Mandy	Southern Alliance for Clean Energy	Letter (ML101740336)	0011
		Letter (ML101820355)	0011

Table D-3. (contd)

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
		Letter (ML101820355)	0030
		Letter (ML101900426)	0030
		Meeting Transcript (ML101760446)	Comments the same as Correspondence ID #0011
Hansborough, Hilbert J.		Letter (ML101890551)	0028
Hicks, Katie	Clean Water for North Carolina	Letter (ML101740343)	0017
		Meeting Transcript (ML101760446)	Comments the same as Correspondence ID #0017
Hildebrandt, Lorena		Meeting Transcript (ML101760446)	0001-23
Hogue, David	Mayor of Blacksburg, SC	Meeting Transcript (ML101760446)	0001-4
Hopper, Sara	South Carolina Manufacturers Alliance	Meeting Transcript (ML101760446)	0001-14
Howarth, Robert F.	Western N. Carolina Physicians for Social Responsibility	Letter (ML101740337)	0012
		Meeting Transcript (ML101760446)	0001-27
Ledford, Judy and Glenn		Email (ML101750766)	0022
LeVander, Valerie	Global Warming Task Force of Henderson Co. NC	Letter (ML101740342)	0016
		Meeting Transcript (ML101760446)	Comments the same as Correspondence ID #0016
Littlejohn, Lanny F.	South Carolina	Letter (ML101740332)	0007
McCall, Pat		Email (ML101720649)	0018
Mixon, Michael C.	Shaw Power Group	Email (ML101740613)	0027

Table D-3. (contd)

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
Mominee, Katharine N.	DBNPS Chemistry	Email (ML101720644)	0019
Moss, Dennis Carroll	South Carolina	Letter (ML101740333)	0007
		Meeting Transcript (ML101760446)	0001-1
Moss, Steve	South Carolina	Letter (ML101740331)	0007
		Meeting Transcript (ML101760446)	0001-2
Olsen, Mary	Southeast Office of Nuclear Information and Resource Service	Letter (ML101740340)	0014
		Meeting Transcript (ML101760446)	0001-15
Pace, Eric	Carolina Chapter of the N. American Youth Generation in Nuclear	Meeting Transcript (ML101760446)	0001-21
Peeler, Harvey S.	South Carolina	Letter (ML101740344)	0007
Pennington, Lee		Letter (ML102030058)	0033
Richards, Kitty-Katherine		Meeting Transcript (ML101760446)	0001-19
Richardson, Don	Western North Carolina Physicians for Social Responsibility	Letter (ML101740341)	0015
		Meeting Transcript (ML101760446)	0001-25
Robbs, Kayla	Cherokee Co. Chamber of Commerce	Meeting Transcript (ML101760446)	0001-18
Scott, Darrell	South Carolina Chamber of Commerce	Meeting Transcript (ML101760446)	0001-10
Smith, Brian		Email (ML101750767)	0024
Smith, Clyde E. (Butch)	Cleveland County Water	Letter (ML102070103)	0035

Table D-3. (contd)

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
Swinton, D.C.	Palmetto Environmental Action Coalition	Meeting Transcript (ML101760446)	0001-24
Thomas, Bill	Pisgah Group, NC Sierra Club	Email (ML101810248)	0029
Thomas, Ellen		Email (ML102290314)	0038
		Letter (ML101740339)	0013
Thrift, Debbie	Cliffside Modernization Project	Email (ML101740618)	0025
Vejdani, Vivianne	SC Department of Natural Resources	Letter (ML102160393)	0036
Ware, Steve	Nestle Prepared Foods	Meeting Transcript (ML101760446)	0001-7
Williams, Debralee		Meeting Transcript (ML101760446)	0001-28
Wilson, Caroline D.	South Carolina Dept. of Archives and History	Email (ML101720651)	0020
Zeller, Lou	Blue Ridge Environmental Defense League	Meeting Transcript (ML101760446)	0001-9

D.2.2 Supplemental Scoping In-Scope Comments and Responses

The in-scope comment categories for the supplemental scoping process are listed in Table D-4 in the order that they are presented in this EIS. The comments and responses for the in-scope categories are included below the table. Parenthetical numbers shown after each comment refer to the comment ID number (correspondence number-comment number) and the commenter name.

Table D-4. Supplemental Scoping Comment Categories in Order as Presented in this Appendix

D.2.2.1	Comments Concerning Process – COL
D.2.2.2	Comments Concerning Process – NEPA
D.2.2.3	Comments Concerning Site Layout and Design
D.2.2.4	Comments Concerning Land Use – Site and Vicinity
D.2.2.5	Comments Concerning Hydrology – Surface Water
D.2.2.6	Comments Concerning Hydrology – Groundwater
D.2.2.7	Comments Concerning Ecology – Terrestrial
D.2.2.8	Comments Concerning Ecology – Aquatic
D.2.2.9	Comments Concerning Socioeconomics
D.2.2.10	Comments Concerning Historic and Cultural Resources
D.2.2.11	Comments Concerning Health – Radiological
D.2.2.12	Comments Concerning Accidents – Severe
D.2.2.13	Comments Concerning the Uranium Fuel Cycle
D.2.2.14	Comments Concerning Transportation
D.2.2.15	Comments Concerning Decommissioning
D.2.2.16	Comments Concerning Cumulative Impacts
D.2.2.17	Comments Concerning the Need for Power
D.2.2.18	Comments Concerning Alternatives – Energy
D.2.2.19	Comments Concerning Alternatives – System Design
D.2.2.20	Comments Concerning Benefit-Cost Balance

D.2.2.1 Comments Concerning Process – COL

Comment: A number of you were at the scoping meetings in 2008, and I'm quite concerned that at that time this issue of insufficient water was not addressed during scoping. A lot of the members of the public spoke out, and the NRC has said that tonight, and I want a full explanation of why the issue of inadequate water for the reactors was not discussed at that time, and I don't think that we've heard that reason tonight. (**0001-31-1** [Clements, Tom])

Comment: Duke was aware of water demands at the time of the EIS scoping meeting so it is hard to understand why this lake is being proposed now and not at the start of the whole EIS process. This reflects very poorly on both Duke and the NRC in that the water supply and use issue was of concern to the public 1.5 years ago and the low-flow impacts well-known at that time. (**0002-3** [Clements, Tom])

Comment: If the NRC had been on its toes and truly working in the public interest, this issue of need for more water would have been on the table from the start of the environmental review process. That the NRC did not realize or admit the stresses being posed to the Broad River by the proposed reactors, as was reflected in a letter from the SC Department of Natural Resources, with which I'm sure you are familiar, is hard to accept. This does call into question the NRC's ability to adequately review Duke's environmental documentation. (**0002-4** [Clements, Tom])

Comment: I expect a full public explanation to be offered both by the NRC and Duke as to why we have only learned this far along into the process about the need for a new make-up water lake (of unknown size). Many of us saw this coming a long time ago and speculated on the possibility that Duke would pose a new lake, so either the NRC and Duke are way behind in their analysis of impacts to the Broad River or the plan for a new lake existed earlier and is only just now being revealed. But I am open to any other explanation as to why we are only learning about this proposed lake at this late point. (**0002-5** [Clements, Tom])

***Response**: The NRC's regulations that implement the National Environmental Policy Act of 1969 (NEPA) are contained in Title 10 of the Code of Federal Regulations (CFR) Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." Title 10 CFR 51.29(a)(2) states that scoping will "Determine the scope of the statement and identify the significant issues to be analyzed in depth." Scoping for the environmental impact statement (EIS) should ensure that public and agency concerns are identified early and properly studied. In the case of Make-Up Pond C, it was during the original scoping process that the South Carolina Department of Natural Resources (SCDNR) identified the need for a contingency supply of cooling water during periods of low flow in the Broad River. The identification of the Broad River low-flow issue by SCDNR is an example of how NEPA and the scoping process were successfully implemented. As a result, Duke Energy Carolinas, LLC (Duke) amended the Lee Nuclear Station project by adding the proposed Make-Up Pond C to* *serve as a source of supplemental cooling water during low-flow periods in the Broad River. The NRC and the U.S. Army Corps of Engineers (USACE) considered this a big enough change to the Lee Nuclear Station project scope to necessitate another round of scoping and another public scoping meeting.*

The SCDNR letter can be found in the NRC Agencywide Documents Access Management System (ADAMS) under Accession No. ML081430553 (SCDNR 2008). ADAMS is accessible at http://www.nrc.gov/reading-rm/adams.html. Persons who do not have access to ADAMS or who encounter problems in accessing the documents located in ADAMS should contact the NRC Public Document Room reference staff by telephone at 1-800-397-4209 or 301-415-4737, or via e-mail at pdr@nrc.gov.

The NRC and the USACE are in the process of examining the environmental impacts of building and operating the Lee Nuclear Station (and Make-Up Pond C) and will address water use issues in Chapter 5 of the draft EIS. At the time of the original and supplemental scoping periods, the NRC was not in the position to make any preliminary determinations regarding environmental impacts associated with the proposed Lee Nuclear Station.

Comment: Again, back to the issue of federal agencies working together and disclosure. You're working with the Army Corps of Engineers; that's good. But how about the National Oceanic and Atmospheric Administration? How about the projections for the droughts that are on their records for this area? (**0001-15-11** [Olsen, Mary])

***Response**: Title 10 CFR 51.28 identifies who should be invited to participate in the scoping process, which includes Federal, State, and local agencies, and affected Native American tribes. The NRC's environmental review process invites other governmental agencies to assess whether or not they should be considered cooperating agencies under the regulatory structure afforded by the President's Council on Environmental Quality. The environmental review process also invites these agencies to identify whether or not they have a particular expertise on an issue that may be invaluable to the NRC, or have consultation roles under other statutes that have a bearing on site-specific issues.*

For the Lee Nuclear Station environmental review, the NRC has contacted Federal agencies such as the U.S. Fish and Wildlife Service and the American Council on Historic Preservation, numerous Native American tribes, and South Carolina and North Carolina resource agencies. As the comment states, the USACE Charleston District is participating in the environmental review as a cooperating agency. The NRC may also use data from other Federal and State agencies when evaluating the environmental impacts of building and operating the Lee Nuclear Station.

Comment: A couple years ago reactors, like I said earlier, were closed down because of a drought in our area in Tennessee. I want to be assured that the Army Corps of Engineers and the NRC can be trusted with this project. (**0001-20-3** [Bliss, Rachel])

Comment: I want to be assured that the Army Corp of Engineers and the NRC can be trusted with this project. In recent years they have failed us along with corporations they regulate. (**0009-3** [Bliss, Rachel])

Comment: I know you cannot (for reasons I fail to understand) address anything but this permit and have brought our concerns to the further attention of Congress and the President. (**0010-5** [Arnason, Deb])

Comment: I have been here before with the NRC when I attended Gaffney SC hearing on this Lee reactor May 1, 2008. I was informed, in a joking way, by a NRC employee that my opposition was useless and this Lee Reactor was a foregone conclusion. (**0010-9** [Arnason, Deb])

Response*: NRC approval of an application for a combined license (COL) is not a foregone conclusion. The NRC's responsibility is to regulate the nuclear industry to protect public health and safety, and the environment. Accordingly, the licensing process for COL applications is specified in 10 CFR Part 52. The NRC's environmental regulations are contained in 10 CFR Part 51 and guidance for NRC staff responsible for environmental review of new reactor license applications is documented in NUREG-1555 (NRC 2000), Standard Review Plans for Environmental Reviews for Nuclear Power Plants. The environmental review process includes a detailed review of an applicant's COL application, and considers public comments received during scoping periods as well as consultations with Tribal, State, and Federal agencies to determine the environmental effects of building and operating the nuclear power facility.*

By letter dated February 10, 2009, NRC received official notice of the USACE's interest in becoming a cooperating agency for the Lee COL EIS (ADAMS Accession No. ML090690283) (USACE 2009). The NRC agreed by letter dated March 30, 2009 (ADAMS Accession No. ML090700384) to invite USACE to serve as a cooperating agency in the preparation of the EIS for this licensing action (NRC 2009). USACE is committed to following the letter of the law (i.e., the Clean Water Act) as it applies to the proposed Lee Nuclear Station project.

Comment: The Catawba wishes to be consulted on any ground disturbing activities on this project. (**0039-1** [Haire, Wenonah G.])

Response*: As outlined in 36 CFR 800.8(c), "Coordination with the National Environmental Policy Act of 1969" (NEPA), the NRC is coordinating compliance with the National Historic Preservation Act, Section 106, in fulfilling its responsibilities under NEPA. The NRC will consult with the Catawba Indian Nation for NRC-authorized activities associated with the Lee Nuclear Station COL application. The Catawba Indian Nation will have an opportunity to consult and* *comment on the project through the NEPA process. The NRC will provide the Catawba Indian Nation copies of Duke's responses to NRC requests for additional information and associated cultural resource reports.*

Comment: I believe if more people in support of these projects were kept well informed there would be a greater attendance and more of a show of support. I was not aware of the public hearing last week or I too would have attended in person. (**0025-2** [Thrift, Debbie])

***Response**: The NRC staff used a number of methods to inform the public about the scoping meeting. The "Notice of Intent to Conduct a Supplemental Scoping Process for the Supplement to the Environmental Report" was published in the Federal Register on May 24, 2010 (75 FR 28822). In addition, public notice was provided through local newspaper ads and press releases, as well as on the NRC website. Meeting announcements were published in the following local newspapers: The Gaffney Ledger, Spartanburg Herald-Journal, York Enquirer-Herald, The State* (Columbia)*, Blacksburg Times, Charlotte Observer, and Gaston Gazette. The staff appreciates the concern raised by the commenter and will continue to look for ways to improve public notification of these meetings.*

D.2.2.2 Comments Concerning Process – NEPA

Comment: So cutting now to the scoping issues, the National Environmental Policy Act does allow consideration of options, of course; that's what the whole process is. There's a no-action alternative. But currently I have never heard of a federal agency being honest about the situation that we're in with this site. (**0001-15-3** [Olsen, Mary])

***Response**: The no-action alternative; i.e., denial of COL, energy conservation and efficiency, demand-side management, new generation alternatives, purchased electrical power, alternative energy technologies (including renewable energy resources such as wind and solar), and the combination of alternatives will be addressed in Chapter 9 of the EIS. For acceptable alternatives, the potential for environmental impacts will be assessed against that of the proposed Lee Nuclear Station. If one of the acceptable alternatives is environmentally preferable to the proposed action, economic impacts will also be compared.*

D.2.2.3 Comments Concerning Site Layout and Design

Comment: A couple things about the AP-1000 reactor, and I want to point out a few things because the NRC hasn't done it, from the environmental report. If people don't know, the reactors that are being looked at here have never been built anywhere in the world. They are under construction in China, but they have never been built anywhere. The design is not certified in the United States, and they do not have a license from the Nuclear Regulatory

Commission. So why is so much site preparation going on at the Duke site here and at the SCE&G site if the reactors aren't even licensed and the whole overall project does not have a license? (**0001-31-4** [Clements, Tom])

***Response**: Revision 15 of the Westinghouse AP1000 Design Control Document (DCD) is a certified design (10 CFR Part 52, Appendix D). In its COL application (Duke 2007), Duke referenced Revision 17 to the AP1000 DCD (Westinghouse 2008), which NRC accepted for review but has not yet approved. NRC regulations allow the applicant for a COL to reference a design that is undergoing design certification. Site preparation activities not related to nuclear safety, also termed preconstruction activities, may be performed by the applicant prior to the conclusion of the COL application review. The impacts of preconstruction activities will be addressed in Chapters 4 and 7 of the EIS. Applicants engaging in preconstruction activities do so at their own risk as NRC approval of an application for a COL is not a foregone conclusion. This comment provides no new information related to the environmental review of the proposed action and will not be addressed in the EIS.*

D.2.2.4 Comments Concerning Land Use – Site and Vicinity

Comment: Flooding the area for Make-Up Pond C will flood valuable farmland (**0037-7** [Breckheimer, Steve])

***Response**: A description of current land uses, as well as land-use impacts during development and operation of the proposed facilities will be discussed in Sections 2.2, 4.1, and 5.1 of the EIS. Additionally, Chapter 10 will discuss Irreversible and Irretrievable Commitments of Resources, in accordance with Section 102(2)(C)(v) of NEPA.*

D.2.2.5 Comments Concerning Hydrology – Surface Water

Comment: I do want to mention briefly the construction of Pond C. Pond C is a critical component to the Lee Station's success. Duke Energy also evaluated the environmental impact of the pond and concluded that it would result in the least impact to the environmental as compared to other options. (**0001-10-4** [Scott, Darrell])

Comment: We're talking about water withdrawals; we're talking about Pond C. We are in a situation where power generated with steam is causing two-thirds of the water we take out to not produce any power at all. It's just thermodynamics; it's just condensing steam back to water to make power. So if we do the numbers on this site, the projections are more than 30 million gallons a day, but round down to make it easy: 30 million gallons a day that's actually like, you know, going off the site as steam. Two-thirds of that, or 20 million gallons, didn't even make electric power. (**0001-15-7** [Olsen, Mary])

Comment: I think it's time that our federal agencies put into their disclosures the withdrawal of water that could be drinking water, that could be used in an environmental natural ecosystem versus uselessness. (**0001-15-8** [Olsen, Mary])

Comment: I'm concerned about the state of the Broad River if another containment pond is built using water that would ordinarily go into the Broad River directly. We need further information about how this water use will affect communities downstream (**0001-20-1** [Bliss, Rachel])

Comment: Duke Energy's proposal for this cooling lake demonstrates the flaws of the Lee nuclear reactor plans in regards to water. According to Section 5.2.1 of Duke's report on the environmental impacts of the Make-Up Pond C, the necessity of this cooling lake is due to the need to compensate for low flow on the Broad River. They admit in their report that the region has been drought-stricken in the past and continues to be. My question to the Nuclear Regulatory Commission, as well as Duke Energy, is why permit or build a nuclear reactor, which, according to the Department of Energy, is the highest water consumer of any energy technology, in a drought-prone area, especially when, according to climate models, we face an escalating threat of future droughts in the region. (**0001-23-1** [Hildebrandt, Lorena])

Comment: I'd also like to see information in the environmental report on how long the make-up ponds would last in case of low flow and drought in the Broad River. (**0001-23-2** [Hildebrandt, Lorena])

Comment: I want to know now how much evaporation there is from the lake and what's going to replace the evaporated water. Is that going to come from this tiny little creek? Or is it going to be pumped from the Broad River? (**0001-31-10** [Clements, Tom])

Comment: Also, what happens to London Creek when the lake is emptied down to its lowest amount and possibly there's not any discharge to the Broad River? We heard that it's going to go down to 17,500 acre feet, I believe, so what happens to the creek under these circumstances? (**0001-31-11** [Clements, Tom])

Comment: As I said, you don't have to be against nuclear power to be concerned about how this is going to impact the Broad River. We heard at the earlier scoping meeting, we heard tonight that if this project goes forward, the name of the Broad River is going to have to be changed to the Skinny River, but I'd go just a little bit further. Because of the hot water being discharged into the river, that's going to affect aquatic life downstream, we might well just have to change the name to the Hot & Skinny River, because that may well be the case if this goes forward. (**0001-31-16** [Clements, Tom])

Comment: And it does appear that this reactor project hinges on this new lake. It's down to the water in a new lake to provide cooling water for the reactors during low flow. And to me, this is an admission of the vulnerability of the project, that it's not really viable, that this is the wrong place for nuclear reactors, even if you're pro-nuclear. If you want nuclear reactors to be built, this is not the place to do it, because the Broad River is not large enough to handle these reactors. (**0001-31-2** [Clements, Tom])

Comment: And I want to dispute something that was said earlier by the representatives who spoke and by the Chamber of Commerce. We heard them say that the new water withdrawal bill that was passed by the legislature this year and signed by the governor is going to regulate these new reactors. Well, that's quite interesting to hear, because at the Nuclear Advisory Council -- the Governor's Nuclear Advisory Council meeting last Thursday a spokesperson from the Department of Health and Environmental Control made clear the new bill does not regulate water withdrawal for nuclear reactors. That's the role of the Federal Energy Regulatory Commission. So there's not going to be any control by the state, it appears. I asked one of the representatives outside to please clarify, and he didn't really want me asking him the question, because they want to make the presentation that the state is going to regulate the water withdrawal, and I don't think that's the case. To read the law it's very unclear, but DHEC's interpretation is that the reactors are not regulated. (**0001-31-3** [Clements, Tom])

Comment: And I wanted to point out -- and some people have already done this, but pulling directly from the Duke environmental documents, they say that 60,000 gallons per minute will be withdrawn from the river, with a use of 28,000 gallons per minute, maximum. According to my calculations, this is 86 million gallons a day withdrawn from the river, and 41 million gallons used through evaporative cooling. (**0001-31-5** [Clements, Tom])

Comment: Also, the environmental report says that Make-Up Pond C will have a maximum depth of approximately 116 feet, that the dam height will be 132 feet, and to me -- and its 620 acres in size. And to me this is a lake and it's not a pond. The environmental report -- and I think this is something that you really need to think about -- says, London Creek, on which the lake would be built, was flowing during both the March and September 2008 sampling events, when they were doing this study. However, between sampling events, London Creek ceased to flow in many places due to severe to extreme drought conditions in the region. And it goes on to say, "Prior to the September sampling period, riffle areas in London Creek dried up, leaving only isolated pools". We're talking about a small creek that's going to provide the emergency water that's need in low-flow periods of the river. This is not a sizeable body of water on which this lake is being proposed. (**0001-31-6** [Clements, Tom])

Comment: I'd like to make a request and then just point out some things that I'd like to see the EIS cover. I request that the NRC, in the tables, provide the volumes in gallons per minute as well as acre-feet, because when you read them, you have to make the interpretations yourself, and the question already came up tonight and the NRC couldn't answer that: How many acre-feet were in gallons. (**0001-31-7** [Clements, Tom])

Comment: Also the question needs to be explained: How many days' worth of use of water for cooling is in this lake? As I recall from the environmental document, it's only a few. This is only going to provide extra operating capacity. I don't know; maybe it's five days. It's not going to provide a margin for keeping the reactors going in any case if there's an extreme drought like we had a few years ago. (**0001-31-8** [Clements, Tom])

Comment: And I want to know how much discharge there is from the new lake into the Broad River at different flows of the river. At some point is there going to be no water discharged from the -- from London Creek and the lake into the river, because it's all being captured for storage? (**0001-31-9** [Clements, Tom])

Comment: An evaluation of the water needs for the station was included as a part of the environmental report. This included a thorough analysis of many factors, such as available water sources; upstream, downstream water users' needs; environmental considerations, and station water needs. It also included a review of historical data, including the potential impact of drought conditions on area water resources and station operation. The Ninety-Nine Islands reservoir will be the primary source of water in this station. In addition, the site currently has two ponds; one designed for station use during drought periods instead of using the Ninety-Nine Islands reservoir. These ponds can be refilled from rain, runoff, and water from Ninety-Nine Islands reservoir during high river flow periods. (**0001-5-2** [Dolan, Bryan])

Comment: Based on our additional evaluation and discussions, as well as alternatives for use, where we considered other options for maximizing the efficient use of water and minimizing our environmental impact, we determined adding another pond on the Lee site would provide additional drought contingency during prolonged droughts and further ensure the availability of water for the regional ecology and downstream water users. (**0001-5-3** [Dolan, Bryan])

Comment: Comments on Make-Up Pond C: And I'm glad you provided some information, and I would like some more, as people have requested: the size of the pond relative to evaporation needs of the reactor. But I'd like those over the life of the reactors. (**0001-6-2** [Arnason, Deb])

Comment: Duke's nuclear power plant at Lee, if constructed, would consume four times as much water as all public and industrial users in Cherokee County combined. (**0001-9-2** [Zeller, Lou])

Comment: Given that we have long know about the possible stresses to the Broad River by the consumptive use of water by the proposed Lee reactors, as was raised more than a year ago during scoping comments, it strikes me as strange that Duke has now come back to propose a new cooling-water lake. It was quite clear last year that the low flow of the Broad River - which one person during oral scoping comments said should be renamed the Skinny River if the reactor project went forward - would not be sufficient to supply both the reactors and provide water for the flow of the river during low-flow periods. (**0002-2** [Clements, Tom])

Comment: Nuclear power plants use enormous amounts of water; in a era of increasing drought and water shortages, we cannot afford to do this. (**0003-4** [Hale, Kendall])

Comment: My understanding is Duke Energy will withdraw the water needed to operate the Lee plant from the Broad River at the Ninety-Nine Islands Reservoir, and that during drought conditions Duke will rely on drought contingency ponds as the source of water for the plant's needs rather than withdrawing water from the Broad River. This seems prudent to me because it will allow for the water in the river during low-flow conditions to be available for downstream users and for protecting the river's ecology. As a South Carolina legislator, I am familiar with the South Carolina Surface Water, Permitting, Use and Reporting Act which was approved by the S.C. legislature and signed by the Governor earlier this month. Duke's proposed plans to withdraw water from on-site drought contingency ponds, during drought periods, is perfectly aligned with what our state environmental permitting and environmental resource agencies advocated in this legislation. Specifically, the legislation states that when minimum flow conditions exist in the river, the water withdrawer is to stop withdrawing consumptive quantities of water from the river and begin withdrawing water from a supplemental source such as a drought contingency pond. Duke Energy is proposing the construction of an additional drought contingency pond, which it would utilize during prolonged drought periods. I fully support Duke's request to construct this additional drought contingency pond. Again, I want to point out that Duke's plans to use two drought contingency ponds during low river flow conditions directly aligns with the expectations and requirements stated in the S.C. surface water legislation. (**0007-2** [Littlejohn, Lanny F.] [Moss, Dennis Carroll] [Moss, Steve] [Peeler, Harvey S.])

Comment: The production of nuclear power compromises our safety in several areas including our right to clean, non radioactive water sources. (**0008-2** [Craig, Anne])

Comment: I am concerned about the state of the Broad River, if another containment pond is built using water that would ordinarily go into the Broad river directly. We need further information about how the water use will affect communities downstream. (**0009-1** [Bliss, Rachel])

Comment: Although Duke has submitted a supplemental plan to construct an additional source of water to be designated Make-Up Pond C, I cannot fathom how it would be enough, especially in times of drought and water wars between southern States. This must also be projected at least 20 years out considering climate change is rapidly drying up this area. How dare we allow for-profit corporations to suck us dry? (**0010-1** [Arnason, Deb])

Comment: I would hope you are aware that each existing and each new reactor will EVAPORATE millions of gallons of water PER DAY PER REACTOR (35Mgw/day@Lee) -unlike paltry lawn watering or car washing regulations where at least the water will find its way back into the water table of the region where it is used! (**0010-2** [Arnason, Deb])

Comment: I have a joke for you, although it's not original: Granting this permit will turn the Broad River into the Skinny River. Please now take my concerns seriously or the fallout will be on all of us. (**0001-6-4** [Arnason, Deb])

Comment: Does Duke Energy assure you they have the technology and expertise to prevent any disasters or, in this specific case, provide enough water to make up for their projected water evaporation without sacrificing the needs of human beings for fresh water over the next 20 years or the life of the reactor? How can anyone believe that when the future is so uncertain? (**0010-4** [Arnason, Deb])

Comment: The application also mentions that average surface water use (public and industrial) in Cherokee County was 8.4 million gallons per day. This means that on a daily basis the Lee plant could use six to ten times the amount of surface water used by everyone else in the county combined. The plant will be competing with other important water users in South Carolina and the region. Yet, the application does not acknowledge the impacts this may have, nor does it ponder the impacts this could have during severe drought conditions, such as we regularly experience. The NRC needs to address all of these serious issues in the draft EIS. (**0011-11** [Hancock, Mandy])

Comment: The Broad River, from which the Lee site will rely, is already stressed from the drought and a variety of industrial and municipal users. Further, other proposals, such as Duke's efforts to expand the Cliffside coal plant in NC, and SCE&G's proposal to build two reactors in Jenkinsville, SC also aim to use huge amounts of water from the Broad River. The full extent of these proposed impacts are not discussed in the application. The NRC needs to analyze not only the Broad River of today, but the Broad River of tomorrow, which is slated for more development. The application even states that an estimated 56 percent increase in water demand is projected from 1997 to 2020 for the North Carolina portion of the Broad River basin. How will the Broad River be able to provide enough water for all these needs? (**0011-12** [Hancock, Mandy])

Comment: The proposal to impound the Broad River to create a 620 acre make up pond would forever alter the ecosystem of this area. These risks are not adequately addressed in Duke's revised report. (**0011-2** [Hancock, Mandy])

Comment: Duke and the NRC already know that this region has historically suffered from severe droughts as Duke's revised report references the 2005 South Carolina Water Use Report Summary that says the last multi-year drought was in 2008. The National Drought Mitigation Center shows the immediate vicinity of Gaffney to be currently suffering abnormally dry conditions. The Supplement lists recorded statewide droughts since 1925 that show a pattern of getting more frequent and longer lasting droughts. The proposal of creating Make Up Pond C is simply illogical-what actually makes sense is to pursue less water intensive energy options to begin with instead of costly engineering measures that will negatively impact the environment, add to the cost, and ultimately waste even more water. (**0011-7** [Hancock, Mandy])

Comment: According to Duke's application, the two Lee reactors will withdraw during normal use 50-86 million gallons of water per day (mgd) from the Broad River 9 and consume, or lose, 35-41 mgd resulting in an overall consumptive loss of approximately 50-70%.'?? This is unacceptable in a region in which water resources are already stressed.
(**0011-9** [Hancock, Mandy])

Comment: Duke and SCG&E are planning Cliffside Coal Plant and 5 nuclear reactors on the Broad (2 at Lee in Gaffney and 3 at Summer in Jenkinsville). This is not sustainable and jeopardizes the entire Broad River watershed and drinking source for Columbia, SC.
(**0013-10** [Thomas, Ellen])

Comment: The water withdrawals from the Broad River are in direct conflict with drinking water needs of Columbia, SC and will have its greatest impact during draught when the water needs of the City will be greatest. (**0014-2** [Olsen, Mary])

Comment: We strongly oppose the proposed reactors for many reasons. First, the water evaporation from the Broad River due to cooling operations would be unacceptable. The Broad River already receives hot discharges and loses water from THREE other existing or planned nuclear reactors in SC and a coal plant in NC. In addition to the 47 million gallons of water per day the facility would withdraw, returning only a quarter of this amount, our calculation based on the reactor specifications indicate that the facility could cause evaporation of up to five and a half BILLION gallons per year in "forced evaporation" downstream due to hot discharges. This reduced flow is harmful to wildlife and reduces the amount of water available to downstream communities, such as Union and Columbia, who use the Broad as a drinking source. Construction of cooling pond C would not improve the state of the Broad River, as London Creek is tributary to the river, and thus any evaporation from the pond will impact overall river flows. The mean monthly discharge of many NC rivers and streams has been generally decreasing in the past decade, due to two extended periods of drought. Especially with these drought conditions and the possibility of interstate water conflicts, a closer examination of the allocation implications of permitting these reactors is imperative. (**0017-1** [Hicks, Katie])

Comment: I strongly urge development of at least the third pond identified in the June 18, 2010 Craig Peters Report distributed by NEI. There is no debate regarding paramount concerns for confidence and assured availability of uninterrupted cooling water sources, and there have been recent instances of extreme drought in the southern regions.. There is not debate that all engineering / mechanical advantages available to provide uninterrupted water source must be perused. It is my opinion that additional water ponds should also be considered for simple process water hold-up. Typical examples would be a hold up pond for circulating cooling water to provide short term hold up on site for oxidation biocide degradation and/or station drain run-off hold-up ponds for the inadvertent oil leaks, both providing short term hold-up/mitigation potential prior to return to open water sources. (**0019-2** [Mominee, Katharine N.])

Comment: Water is an issue. Droughts and heat waves cause nuclear reactors to be unreliable and inoperable because federal regulations require plants to shut down when water temperatures reaches 90 degrees. (**0021-4** [Barnett, Barbara A.])

Comment: The Lee plants cannot function without 50 million gallons of water a day from the Broad River and 35 million gallons would evaporate from the cooling towers. Nuclear Reactors would consume four times as much water as all public and industrial users in Cherokee County combined (Duke Energy License Application Environmental Report Sec. 2.3.2). In the summer South Carolina is hot and humid with daytime temperatures averaging near 90 degrees and have reached 100 degrees. (**0021-5** [Barnett, Barbara A.])

Comment: This nuclear plant will require the construction of a lake to ensure a reliable source of cooling water, consuming up to 55 cubic feet of water per second from the Broad River. With global warming/climate change there can be no assurance that the flow of the Broad River will remain at its current levels or that its water will be essential for drinking or agriculture in the future. (**0029-6** [Thomas, Bill])

Comment: The proposal to impound the Broad River to create a 620 acre make up pond would forever alter the ecosystem of this area. These risks are not adequately addressed in the Environmental Report and must be thoroughly examined by the Nuclear Regulatory Commission (NRC) in the draft Environmental Impact Statement (DEIS).
(**0030-1** [Barczak, Sara] [Hancock, Mandy])

Comment: This region has historically suffered from severe droughts. Yet Duke's application references the 2005 South Carolina Water Use Report Summary that says the last multi-year drought was in 1998. The National Drought Mitigation Center shows the immediate vicinity of Gaffney to be currently suffering abnormally dry conditions. The Supplement lists recorded statewide droughts since 1925 that show a pattern of getting more frequent and longer lasting. The proposal of Make Up Pond C, to be used to provide supplemental water during drought and/or low flow periods in a region prone to severe drought and temperatures, seems extreme and dangerous. (**0030-5** [Barczak, Sara] [Hancock, Mandy])

Comment: According to Duke's application, the two Lee reactors will withdraw during normal use 50-86 million gallons of water per day (mgd) from the Broad River and consume, or lose, 35-41 mgd, returning only 30-50% back to the river. Overall consumptive loss will be approximately 50-70%. This is unacceptable in a region in which water resources are already stressed. The application also mentions that average surface water use (public and industrial) in Cherokee County was 8.4 million gallons per day. This means that on a daily basis the Lee plant could use six to ten times the amount of surface water used by all other users in the county combined. Though the proposed plant will be competing with other important water users in South Carolina and the region, the application does not acknowledge the impacts this may have, nor does it ponder the impacts this could have during severe drought conditions. The NRC needs to address this in the DEIS. (**0030-6** [Barczak, Sara] [Hancock, Mandy])

Comment: The Broad River, from which the Lee site will rely, is already stressed from the drought and a variety of industrial and municipal users. Further, other proposals, such as Duke's efforts to expand the Cliffside coal plant in North Carolina, and SCE&G's proposal to build two reactors in Jenkinsville, South Carolina at the V.C. Summer site also aim to use huge amounts of water from the Broad River. The full extent of these cumulative impacts is not discussed in the application. The NRC needs to analyze not only the Broad River of today but also the Broad River of tomorrow, which is slated for more development. The application states that an estimated 56 percent increase in water demand is projected from 1997 to 2020 for the North Carolina portion of the Broad River basin. How will the Broad River be able to provide enough water for all these needs? (**0030-7** [Barczak, Sara] [Hancock, Mandy])

Comment: Also, downstream of the proposed Lee facilities the Broad River enjoys our state's Scenic River status, reflecting a stream of exceptional quality and diversity. Hence, measures to protect these assets are not only prudent, but should be required by the license and related permits. (**0032-2** [Gregg, Ben])

Comment: It is our understanding that Duke's proposed water withdrawals are consistent with the spirit, intent, and specifications of the [South Carolina Surface Water Withdrawal and Reporting] Act. (**0032-4** [Gregg, Ben])

Comment: the proposed water management plan presented by Duke appears consistent with the requirements of its FERC license for the Ninety-Nine Islands Hydroelectric Station. (**0032-5** [Gregg, Ben])

Comment: I am not satisfied that there will be enough water to service this proposed reactor due to our severe recent drought and associated water evaporation. (**0034-1** [Hallock, Judith])

Comment: Given the fact that the proposed power plant is a regional solution we are perplexed as to why Duke Energy has not considered a more regional option to supply the additional storage of water for the project. CCW has been working for more than 10 years on the development of a reservoir on the First Broad River to supply potable water for our water system as well as the City of Shelby water system. CCW presented this idea to Duke Energy during its study of the Broad River Water Supplies conducted in 2007. It is our understanding that Duke's study indicated there was an inadequate supply of water from the Broad River during extreme drought conditions and that an additional supply of raw water was needed for cooling water for the proposed Lee Nuclear Station. Duke's conclusion as to inadequate water supply supports the position of CCW as to the need for an additional supply of raw water. (**0035-2** [Smith, Clyde E. (Butch)])

Comment: Now that a second reservoir is needed (Make-up pond C) CCW requests that USNRC and the USACOE re-evaluate the use of a proposed joint reservoir on the First Broad River. (**0035-3** [Smith, Clyde E. (Butch)])

Comment: The ER Supplement states that the proposed Make-Up Pond C would be an off-site, man-made reservoir, formed by impounding London Creek; a tributary of the Broad River, northwest of Make-Up Pond B. Make-Up Pond C would be used to provide supplemental water during drought and/or low flow periods. Make-Up Pond C would be filled using water pumped through Make-Up Pond A and Make-Up Pond B, or directly from the Broad River. The Make-Up Pond C dam would be downstream of Lake Cherokee and upstream of the confluence of London and Little London creeks. The Make-Up Pond C dam crest elevation would be 660 ft msl, and the spillway crest elevation would be 650 ft msl. Make-Up Pond C would have a maximum depth of approximately 116 ft and a total storage volume of approximately 22,000 ac-ft. The surface area at the normal pond level of 650 ft msl would be approximately 620 ac. The usable storage capacity would be approximately 17,500 ac-ft. Normal water surface elevation for the proposed Make-Up Pond C would be 650 ft. At times when natural stream flows to Make-Up Pond C are inadequate to maintain a full pool condition, the reservoir would receive supplemental inflows from the Broad River. If permitted, Pond C, at 632 acres would be the largest reservoir permitted in the state of South Carolina since Lake Russell in the mid-l 970s. (**0036-1** [Vejdani, Vivianne])

Comment: The proposed flooding of approximately 6 mi of stream will require mitigation for unavoidable impacts to waters of the U.S. as required by section 404(b)(1) of the Clean Water Act, consistent with criteria set forth in the Federal Mitigation Rule (Rule). The Rule establishes set criteria, or elements, that must be addressed in every mitigation plan. Among these 12 elements is the collection of baseline information for the impact site. In keeping with this requirement, a geomorphological assessment of the entire reach of London Creek and its tributaries within the impact zone should be conducted. This geomorphological assessment should include, but not be limited to, the following:

- Dimension, pattern and profile features of London Creek and its tributaries,
- Bankfull width, discharge and velocity of London Creek,
- Substrate analysis for London Creek and tributaries, and
- Inventory of riffle/pool complexes, falls, shoal areas and woody debris in London Creek and tributaries.

These baseline monitoring parameters will be necessary to ensure that aquatic habitat quality in the mitigation reaches is commensurate with impacted reaches, and appropriate mitigation is provided to replace lost values and functions of London Creek and its tributaries if they are impounded.

In order to adequately mitigate all identified impacts, the Licensee will be required to develop a comprehensive mitigation plan. For impacts to the amount of wetlands and stream that will be involved to develop Pond C, such a mitigation plan should encompass more than simple wetland and stream impact restoration and compensation. DNR requests continued discussion with the Licensee and appropriate regulatory agencies regarding mitigation to include identification of the potential impacts to fish, wildlife and habitat resources by the construction of Pond C. (**0036-12** [Vejdani, Vivianne])

Comment: DNR has concluded the Licensee has conducted a thorough and exhaustive review of the need for obtaining additional water supply for safe operation of the proposed facility during periods of extreme drought. A number of the alternatives that have been put forward for additional water supply represent engineering solutions exceeding the capability for DNR analysis. DNR is satisfied the Licensee has identified the least damaging alternative to natural resources for provision of additional water supply based on comparison of alternative supplemental water supply options. (**0036-13** [Vejdani, Vivianne])

Comment: The proposed Pond C would back up to and interface directly with the Lake Cherokee dam, thus resulting in a number of potential impacts, such as the need for modification of the existing dam and emergency spillway, fencing and rip-rap of the down slope. DNR and the Licensee have been engaged in productive discussion regarding avoidance and minimization of impacts to Lake Cherokee and its public use. (**0036-3** [Vejdani, Vivianne])

Comment: There is not enough water from the river to feed additional nuclear plants; the water will be needed for drinking and growing food. During extended drought, the units will have to be taken off line when the pond water runs out. (**0037-5** [Breckheimer, Steve])

Comment: Duke and SCG&E are planning to expand Cliffside Coal Plant and want to add 5 new nuclear reactors (2 at Lee in Gaffney and 3 at Summer in Jenkinsville) on the mis-named Broad River, perhaps hoping that there will be no droughts such as those in 2005 and 2008. This jeopardizes the entire Broad River watershed and drinking source for Columbia, SC -- and other farms and towns downstream, all the way to the Atlantic. (**0038-1** [Thomas, Ellen])

Comment: The C-Pond would wipe out a substantial piece of forest, and would be dependent upon a stream which is known to have dried up during the drought of 2008, or (if pumped out of the Broad River) would significantly reduce the amount of water that would be needed downstream for agriculture and drinking water. (**0038-5** [Thomas, Ellen])

***Response**: In the EIS, the review team will describe Make-Up Pond C, disclose the impacts to water resources, and discuss possible alternatives that would either eliminate the need for Make-Up Pond C or reduce its impacts. In Chapter 3, the review team will describe Make-Up Pond C and the dam that will impound the water that will form Make-Up Pond C. In Sections 4.2.1 and 5.2.1, the review team will discuss alterations of the hydrological system that will result during the development of Make-Up Pond C and during the operation of Make-Up Pond C, including the projected changes in downstream flows and the overall water budget for the plant during operation. In Sections 4.2.2 and 5.2.2, the review team will disclose the impacts to water resources, including downstream flows under current and reasonably foreseeable future conditions. In Section 9.4, the review team will discuss possible alternatives to the proposed system design that could either eliminate the need for Make-Up Pond C or reduce its impacts.*

Comment: I see from the report you sent me that this is probably a useless exercise once again since this public comment supplemental scoping process is designed to weed out anything but comments on Make-Up Pond C for which you admittedly do not provide clear or easily-accessed information (size of pond relative to evaporation needs of reactor over the life of the said reactor(s), impacts on source and disbursement of pond water or radioactive contaminants expected, effects on environment in best and worst case-scenarios, etc.) (**0010-8** [Arnason, Deb])

***Response**: As stated in the response above, the draft EIS will present the results of the review team's analysis of environmental impacts associated with construction and operation of the proposed Lee Nuclear Station and Make-Up Pond C. The NRC maintains a webpage that contains links to documents associated with the Lee Nuclear Station COL review – http://www.nrc.gov/reactors/new-reactors/col/lee.html – including Duke's Environmental Report, the supplement to the Environmental Report regarding Make-Up Pond C, responses to the NRC's requests for additional information, meeting notices and summaries, and other information.*

Comment: Can you tell me if the proposed new impoundment is on the Lee reactor site or actually on the Broad River itself? (**0002-1** [Clements, Tom])

***Response**: The proposed Make-Up Pond C would be located northwest of the Lee Nuclear Station on London Creek, a tributary of the Broad River.*

D.2.2.6 Comments Concerning Hydrology – Groundwater

Comment: We are also on well water. The last time they were blasting and working at that site, some people in the area lost their wells and water. What are your plans to see we have plenty of safe water? Who should we contact in case we have a problem with our water supply? (**0033-2** [Pennington, Lee])

Response*: The purpose of the EIS is to disclose the environmental impacts of constructing and operating the proposed Lee Nuclear Station. Section 2.3 of the draft EIS will address groundwater resources and Sections 4.2 and 5.2 will address potential impacts to groundwater during construction and operation of the proposed Lee Nuclear Station. The NRC has no jurisdiction over the business practices of private entities, and issues regarding these private business practices will not be addressed in the EIS.*

D.2.2.7 Comments Concerning Ecology – Terrestrial

Comment: How many trees are going to be cut during construction of the lake? And as far as I'm aware, this is a forested area. So a square mile of forest is going to be lost in South Carolina due to the construction of this lake. (**0001-31-15** [Clements, Tom])

Comment: You are clearing for the lake and the site? (**0033-4** [Pennington, Lee])

Response*: Land will be cleared both for construction of the proposed Lee Nuclear Station and for Make-Up Pond C. The Make-Up Pond C area is largely forested. Land clearing impacts for both will be addressed in Chapter 4 of the EIS.*

Comment: We already have a problem with wild animals in this area. What are doing about the animals in the area? (**0033-3** [Pennington, Lee])

Response*: It is unclear to which local wild animal problem the comment refers; therefore, the comment cannot be specifically addressed. However, the potential effects of the construction of the proposed Lee Nuclear Station on invasive biota will be addressed in Chapter 4 of the EIS.*

Comment: Sufficient information has been provided by the Licensee to evaluate the impact of the proposed Pond C on vegetation and cover. In addition to these studies, the Licensee hosted a 2-day site visit to allow DNR staff botanists to conduct a preliminary assessment of vegetation at the London Creek site. DNR personnel observed the London Creek riparian corridor to be minimally disturbed as compared with similar sites in the foothills of the upstate. While the ridge tops are impacted by silviculture practices, the steeper, north-facing bluffs demonstrate little disturbance. The lack of invasive, exotic species attests to the site's relative integrity. (**0036-5** [Vejdani, Vivianne])

Response*: Biological information from available sources, including Duke and the South Carolina Department of Natural Resources will be used to describe the plant and animal communities in the Make-Up Pond C area in Chapter 2 of the EIS. A discussion of existing disturbances to and the relative integrity of extant terrestrial resources (including invasive species) in the Make-Up Pond C area will also be included.*

Comment: The ER Supplement states that London Creek and its associated tributaries and forest cover likely provide a localized travel corridor for some species to and from the Broad River (Ninety-Nine Islands Reservoir) floodplain. This area is a travel corridor for migrating passerine birds which have been demonstrated to use major rivers and associated riparian corridors during migration periods. (**0036-6** [Vejdani, Vivianne])

Comment: 2.4.1.2.2 Birds The following observations were noted:

- A high number of migrant songbird species were observed, indicating that a diversity of migrant species use the forested stream corridor during migration. The connectivity of forested wetlands and river systems has been demonstrated to be important to neotropical migrants. Forested areas are used because they provide the highest density of food resources. Migrant birds have, in some cases, flown thousands of miles and are building reserves to reach breeding grounds and successfully reproduce;
- The widths of riparian stream zones at the London Creek site provides mixed hardwood forest habitat that is becoming more limited in the upstate; and
- Steep rock formations create cove systems within the London Creek site, south of where they are commonly located, contributing to a diversity of habitat for bird species.

(**0036-7** [Vejdani, Vivianne])

***Response**: Biological information from available sources, including Duke and the SCDNR, will be used to describe the plant and animal communities and their functions in the Make-Up Pond C area in Chapter 2 of the EIS. A discussion of migratory bird use of the London Creek watershed as a travel corridor to and from the Broad River floodplain; the contribution of wide riparian corridors to the relative integrity of the Make-Up Pond C area; and the contribution of cove systems to the diversity of avian habitat also will be included. Potential impacts to these communities from construction and operation of the proposed Lee Nuclear Station will be discussed in Chapters 4 and 5 of the EIS.*

Comment: Results of the herpetology study conducted by the Licensee's consultant indicate that, of 66 species that potentially occur onsite, 41 of these species were documented onsite (approximately 60% of potential species). The list of potential species comprised 25 amphibians and 41 reptiles. The study documented the presence of 19 amphibian species (76% of the potential species) and 18 reptile species (43% of the potential reptile species). Observing such a high percentage of potential species within a 1.5-year sampling period is an indication that the site supports a relatively healthy and diverse amphibian and reptile assemblage. Likewise, the salamander diversity observed at the London Creek site also is indicative of a relatively healthy and functional system. The herpetology survey documented 8 of 11 potential salamander species (72% of potential species). (**0036-8** [Vejdani, Vivianne])

Response*: Herpetofauna communities in the Make-Up Pond C area will be described in Chapter 2 of the EIS. A discussion of the diversity and relative integrity of the herpetofauna communities will also be included.*

Comment: The Licensee proposes a 300 ft buffer around the Pond, 50 ft of which is proposed to be cleared, grubbed, grassed and maintained to prevent debris from washing into the reservoir. DNR concurs with the proposed 300 ft buffer but does not support clearing, grubbing, grassing and maintaining a 50 ft buffer adjacent to the shoreline. Pond C would likely naturalize and support a variety of aquatic life and wildlife. Riparian zones perform numerous ecological functions to include, but not be limited to: riparian plant communities provide excellent food, cover, and nesting sites for a variety of wildlife species and detritus and woody debris are an important source of energy and cover for aquatic life. Canopy cover helps to maintain water quality by reducing surface water temperatures. Riparian zones function as biofilters and remove nutrients and other pollutants from stormwater runoff before it enters rivers, lakes and streams. DNR looks forward to continued discussion with the Licensee in order to explore other alternatives for preventing debris from entering intake structures. (**0036-2** [Vejdani, Vivianne])

Response*: The NRC has no jurisdiction over land-clearing practices by Duke. Disposition of the 50-ft cleared buffer that was proposed all the way around and adjacent to Make-Up Pond C remains under discussion between Duke and the South Carolina Department of Natural Resources. The resolution of this issue and any associated impacts will be addressed in Chapter 4 of the EIS.*

D.2.2.8 Comments Concerning Ecology – Aquatic

Comment: DNR conducted a fisheries survey of London Creek per South Carolina Stream Assessment protocol on 12 May 2010. Eighteen species were collected during this sampling event (17 native species), including 4 state conservation priority species. The fish assemblage was similar overall to that reported by the Licensee from their 2008-2009 fish survey. No additional species to those reported by the Licensee were discovered. The sample section was well forested and exhibited habitat conditions consistent with an intact Outer Piedmont watershed with substrate heterogeneity. At the time of DNR sampling, flows were above average. Sampling conducted by the Licensee did not demonstrate the presence of piscivorous fish in London Creek. (**0036-10** [Vejdani, Vivianne])

Comment: Twenty-eight crayfish collections were made by Duke Energy in 2008 and 2009; these were collected and examined in May 2010 to determine species composition. In addition, crayfishes were sampled by DNR and Duke Energy personnel in 2010. Crayfishes collected from London Creek in the area proposed for impoundment (Pond C footprint) included:

- *Cambarus* sp. cf. *acuminatus* (*Cambarus* sp. C) (listed in the ER Supplement as *Cambarus acuminatus*; it is an undescribed species being studied by John Cooper at North Carolina State Museum of Natural Sciences),
- *Cambarus reduncus* (species collected by Duke Energy but not listed in the ER Supplement), and
- *Procambarus acutus*

None of the crayfish species are of conservation concern in South Carolina. Neither shells nor live individuals of any native freshwater mussels were encountered during any of the surveys conducted by DNR in 2010, and they were not discovered by the Licensee during the 2008 and 2009 surveys; thus, London Creek does not appear to support any native mussel species. (**0036-11** [Vejdani, Vivianne])

Comment: The Licensee conducted surveys for fish and macroinvertebrates in 2008. These surveys provide sufficient information regarding fish and macroinvertebrate resources. In addition to this information, DNR conducted a preliminary assessment of fishery and macroinvertebrate communities of London Creek and its tributaries. This assessment revealed that the proposed reservoir will represent the loss of intact Piedmont watershed and associated aquatic habitats and species. Overall, London Creek currently exhibits physical conditions consistent with a quality Piedmont stream, including a forested riparian corridor, channel sinuosity and habitat (riffle/pool) diversity, and coarse, clean substrate composition. London Creek is subject to the fluctuating flows typical of similar Piedmont streams. (**0036-9** [Vejdani, Vivianne])

***Response**: Biological and physical information from available sources, including Duke and the South Carolina Department of Natural Resources, will be used to describe the aquatic communities in and around London Creek in Chapter 2 of the EIS. Potential impacts on these communities from construction and operation of the proposed Lee Nuclear Station will be addressed in Chapters 4 and 5 of the EIS.*

Comment: One of the more challenging hurdles is the issue of minimum release (minimum in-stream flows) from any proposed reservoir. This minimum release is being required by a number of different organizations and resource agencies, including the US Fish and Wildlife Service (USF&WS). We trust that the USNRC and the USF&WS will impose the same requirements for minimum release if the Pond C option is pursued. CCW has discovered that this minimum release, depending upon the number, can have a major impact on the safe yield of any reservoir. The minimum release could impact the size of the proposed 620 acre pond C reservoir. (**0035-4** [Smith, Clyde E. (Butch)])

***Response**: The NRC does not impose requirements for minimum in-stream flow; however, construction and operation of Make-Up Pond C would require authorizations from the USACE (Clean Water Act, Section 404) and the South Carolina Department of Health and*

Environmental Control (Clean Water Act, Section 401) and these agencies could require a minimum in-stream flow. Because the EIS will likely be finalized before such permits are obtained, details of minimum flow requirements, if any, will not be included in the EIS. However, the potential for minimum flow requirements and the potential impacts of station operation on Make-Up Pond C and London Creek will be addressed in Chapter 5 of the EIS.

Comment: And what is the impact to the river of water discharged during low flow that has been heated up, as we've heard before from other speakers, in the lake before it's discharged into the river, if it in fact is discharged? (**0001-31-12** [Clements, Tom])

Comment: What's the impact of siltation to the river during construction? (**0001-31-14** [Clements, Tom])

Comment: "Thermal pollution" kills plants, fish, and other organisms, stressing the entire environment. The proposed W.S. Lee nuclear power plant could withdraw 47 million gallons of water per day from the Broad River and return only 1/4 back to the river. Hot water discharge and the release of radioactive contaminants and hazardous chemicals threaten wildlife and human health. (**0013-4** [Thomas, Ellen])

***Response**: The review team will consider water-quality impacts resulting from construction and operation of the proposed Lee Nuclear Station on the Broad River, including siltation and temperature (thermal) effects, in Chapters 4 and 5 of the EIS. Cumulative water-quality impacts from the proposed Lee Nuclear Station will be addressed in Chapter 7 of the EIS.*

Comment: The Broad River is an irreplaceable resource to our state, providing a unique suite of habitats critical for both wildlife and outdoor recreation. In this reach of the Broad River we have one of the state's few small mouth bass fisheries. (**0032-1** [Gregg, Ben])

***Response**: The Broad River as it relates to wildlife resources and recreation, including the smallmouth bass (Micropterus dolomieu) fishery, will be addressed in Chapter 2 of the EIS. Potential impacts on these resources from construction and operation of the proposed Lee Nuclear Station will be addressed in Chapters 4 and 5 of the EIS.*

Comment: The availability of Make-Up Pond C will essentially establish a floor for withdrawals from the river under these severe conditions. Shifting to Make-Up Pond C will, therefore, substantially mitigate the impacts of the proposed LNS operations during these especially sensitive periods, thereby providing for baseflows protective of recreational and riparian needs downstream, as well as for habitat and wildlife. (**0032-3** [Gregg, Ben])

***Response**: The potential impacts on downstream habitats and recreational activities from Make-Up Pond C operation during drought periods will be addressed in Chapter 5 of the EIS.*

D.2.2.9 Comments Concerning Socioeconomics

Comment: But let's not overlook the other factors that Lee Nuclear Station will bring to this area: the 700-plus jobs that will be permanent for operation of the plant and the average salary that will approach $70,000. The majority of the employees will live in the county; they will spend their money in the county. There will be an influx of approximately 1000 to 1500 additional personnel each year for refueling needs, which will also generate additional revenue in the form of purchasing of food, living accommodations, and other items. There will be several million dollars that will be collected by the county for property taxes. These taxes will be used to improve schools, and as we all know, we do need improvements in our school systems. There will be operating expenses that will be met for the school systems. It will also help fund county services. (**0001-13-2** [Boger, Paul])

Comment: So one point that I want to bring from a worker that I know in Texas about jobs is that while there may be 400 jobs advertised and there may be a multiplier effect that we've heard about this evening from various people, the other multiplier effect is the spouse who comes without a job, because most of these 400 people will move into the area because they require specialized training that's not available in the local community, and they bring with them a spouse and very often one or more teenagers, all of whom are looking for jobs. So you get 400 jobs and about 800 job seekers, so the net for Gaffney is not necessarily an increase in employment -- Gaffney, Blacksburg, this general area. (**0001-15-2** [Olsen, Mary])

Comment: And then all of the major big reactor parts, the vessel and all those things, are made in Japan or South Korea. They have to be ordered years in advance and brought here. We don't make them; we don't have forges big enough in this country. We lost our steel industry -- our big forges years ago.

And so none of this stuff is actually made in the United States. All those jobs, all that money that we're spending to buy that is going to foreign countries. (**0001-30-3** [Corbett, Susan])

Comment: Lee Nuclear Station will benefit our state in other ways, namely by creating thousands of construction jobs, providing hundreds of well paying jobs for decades to come, stimulating the local economy through the addition of service jobs to support the nuclear plant and its workers, and providing a low-cost, safe, reliable, carbon-free, environmentally responsible source of electricity to our citizens.
(**0007-1** [Littlejohn, Lanny F.] [Moss, Dennis Carroll] [Moss, Steve] [Peeler, Harvey S.])

Comment: I have worked several outages within the industry and know how beneficial these plants could be not only to the local economy there in Gaffney but to the entire upstate region. (**0026-2** [Cross, John])

Comment: These proposed plants in the Gaffney area would create an economic boon like nothing that has been experienced in the area and would create hundreds of permanent jobs and the opportunity for many other jobs for the re-fueling outages and work that comes with it. Locoal [sic] housing would benefit, local business and hotels would benefit, local economy as a whole would benefit and South Carolina get s new, clean, viable power source.
(**0026-5** [Cross, John])

Comment: Not only will these plants boost the local economy like never before it will sub -stain a large number of Full time jobs to the area but also will see added temporary jobs during re-fueling and so on. I think that It not need mentioned but this area of the country has lost many of its local jobs to the overseas textile industry causing many local residents to be un-employed.
(**0027-2** [Mixon, Michael C.])

Comment: Workers to run the plant will be brought in from outside the county and will not employ Cherokee County residents. (**0037-6** [Breckheimer, Steve])

Comment: Because of the economy, Duke Power is dredging up support in communities near the proposed plant with promises of jobs and cheap energy. Both of these promises are suspect. (**0038-2** [Thomas, Ellen])

Comment: Historically, most of the people who build and maintain nuclear power plants are seasoned workers who come from other places. They bring families into the community who compete for existing jobs. Once the plant is built, the construction crew will either leave town or be unemployed. (**0038-3** [Thomas, Ellen])

***Response**: Regional socioeconomic impacts such as impacts on the economy, employment, taxes, housing and schools associated with the construction and operation of the proposed Lee Nuclear Station will be considered in Chapters 4 and 5 of the EIS.*

Comment: I would like to see nuclear energy developed in this area. There really is no economic development going on here at this time. I own a 5800 square foot commercial building on Old Georgia Highway in Gaffney and there is no market for it or other similar buildings because there is no new industry in the area. (**0024-1** [Smith, Brian])

Comment: I am thankful that the Duke-Cliffside Modernization Project has provided many jobs for not only NC but also SC and surrounding states and a much needed update to this facility.
(**0025-3** [Thrift, Debbie])

***Response**: These comments generally express support for the proposed action based on the potential positive socioeconomic impacts it would be expected to bring to the region. Socioeconomic impacts from construction and operation of the proposed Lee Nuclear Station will be addressed in Chapters 4 and 5 of the EIS.*

Comment: What happens as population, agriculture needs grow? Will these containment ponds continue to be licensed? (**0001-20-2, 0009-2** [Bliss, Rachel])

Response: *Socioeconomic impacts, such as population growth, will be addressed in Chapters 4 and 5 of the EIS.*

Comment: The ER Supplement indicates the Licensee proposes no public use of the proposed reservoir. DNR appreciates the sensitive nature of operation of a nuclear generation station, however, London Creek constitutes waters of the U.S. and any impacts to it for purposes of a reservoir the size of the one being proposed should include an examination of compatible public use opportunities. These compatible public use opportunities might include fishing and boating opportunities and other compatible appreciative uses along the northern boundary, etc. DNR looks forward to continued discussion with the Licensee regarding potential, compatible public use opportunities on a portion of the proposed Pond C. (**0036-4** [Vejdani, Vivianne])

Response: *Recreational impacts will be addressed in Chapters 4 and 5 of the EIS. Providing public access for recreational activities on or within Make-Up Pond C is outside the scope of NRC's regulatory authority. The USACE role in the EIS as a cooperating agency on the EIS will be addressed in Section 1.3 and its discussion of environmental impacts related to the Clean Water Act in Section 9.5.*

D.2.2.10 Comments Concerning Historic and Cultural Resources

Comment: Based on the description of the Area of Potential Effect (APE) for the project and the identification of historic properties within the APE, SHPO concurs with the assessment that no historical properties listed in or eligible for listing in the National Register of Historic Places will be adversely affected by this project. Also, SHPO concurs with the recommendation for the plans to relocate the Service Family Cemetery (38CK142).

Our office is reviewed the eligibility of the Cherokee Falls Mill Village, as proposed in the survey. We have determined that the village is not eligible for listing on the National Register of Historic Places. (**0020-1** [Wilson, Caroline D.])

Response: *Historic and cultural resources will be addressed in Chapter 2 of the EIS, and impacts on these resources will be discussed in Chapters 4 and 5. The South Carolina State Historic Preservation Officer's concurrence with the assessment of no historic properties adversely affected within the area of potential effects for Make-Up Pond C, concurrence with plans to relocate the Service Family Cemetery, and assessment of the Cherokee Falls Mill Village as ineligible for listing on the National Register of Historic Places will be incorporated into these chapters as part of compliance with the National Historic Preservation Act, Section 106 review process.*

Comment: [Flooding the area for Make-Up Pond C] could cover unique archeological sites. Any environmental impact study should include an archeological survey of the area. (**0037-8** [Breckheimer, Steve])

Response*: The Make-Up Pond C project area has been surveyed for historic and cultural resources, including an inventory and assessment of archaeological sites. The results of this survey will be summarized in Chapter 2 of the EIS and impacts will be addressed in Chapters 4 and 5.*

D.2.2.11 Comments Concerning Health – Radiological

Comment: I'd like impact on source and dispersement of pond water or radioactive contaminants that you expect. I'd like the effects on the environment in the best- and worst-case scenarios, just like this BP thing would certainly have been avoided if something had been looked into beforehand. (**0001-6-3** [Arnason, Deb])

Comment: I'm talking about uranium 235 and plutonium. Just as an example -- and of course these plants turn out a couple hundred isotopes of various half-lives. But look at 238, the so-called depleted uranium. It's all over the Middle East from these shells that were used to penetrate tanks, and they're pyrophoric, so they vaporize, and they float off in the air, and they're in the ground, and the children play in them.

238: It is a half-life of 4-1/2 billion years. That's the half-life of 238: 4-1/2 billion years. How old is this planet? 4-1/2 billion years. Not to worry; it'll be safe in ten half-lives, which is 45 billion years. Some of us aren't going to be here then.

So we have contaminated -- we have already contaminated this earth, the only one we've got, forever. This earth is permanently contaminated with radiation. Everybody in this room -- I'm a doctor, and I've looked into this. Everybody in this room has got some strontium-90 in his bones -- his or her bones.

Your bones, of course, surround your bone marrow, which makes your red and white cells and your platelets, and exposure to radiation by white cells results in leukemia, so the leukemia rate is bound to go up over the years. I'm sorry to say this, but we're all contaminated. (**0001-25-4** [Richardson, Don])

Comment: There is no safe level of radiation. Any potential leak threatens our water and the entire Broad River watershed (**0003-5** [Hale, Kendall])

Comment: I personally would not want to drink water that has just earlier that day been used to cool a nuclear power plant. (**0009-5** [Bliss, Rachel])

Comment: There is no "safe" level of radiation which can damage reproductive cells and lead to genetic mutations and cancer, damage the immune system, cause leukemia and more (World Health Organization) (**0013-5** [Thomas, Ellen])

Comment: U238, has a half-life of 4.5 billion years, the age of our planet. Not to worry, we'll be safe after 10 half-lives, 45 billion years from now. We have thus contaminated Earth forever already, and everyone in this room has some Sr-90 in his or her bones, exposing bone marrow to the risk of leukemias and related malignancies and morbidity (**0015-5** [Richardson, Don])

Comment: the potential for such facilities to pose the threat of severe damage to the environment and to human populations mitigate against the development of nuclear production and delivery services. (**0023-3** [Drake, Joan W.])

Comment: I would not be interested in drinking water or eating fish from the Broad River if I were anywhere downstream of Gaffney. (**0038-7** [Thomas, Ellen])

Comment: Blue Ridge Environmental Defense League opposes this project for a variety of reasons: Harmful radioactive pollution is released into the air and to the water from nuclear power plants on a routine basis. Of course, highly toxic radioactive waste is also stored on site in pools of water. (**0001-9-1** [Zeller, Lou])

Comment: There is great potential for release of radiation into the atmosphere (**0037-3** [Breckheimer, Steve])

Comment: [There is great potential for release of radiation into the ...] water from nuclear plants (**0037-4** [Breckheimer, Steve])

Comment: Our water supply is threatened by the potential for leaking radioactivity from the reactor (documented at dozens of sites today). (**0013-9** [Thomas, Ellen])

Comment: I think of the plant in North Carolina that had to flush out its pipes in the midst of a hurricane, flooding farmlands and pig farms with radioactivity. (**0038-8** [Thomas, Ellen])

***Response**: These comments concern possible health effects from radiation exposure. Chapter 5 of the EIS will address the potential radiation doses and the associated health effects from operation of the proposed Lee Nuclear Station. Impacts related to storage of radioactive waste will be addressed in Chapter 6 of the EIS. Cumulative radiological impacts will be described in Chapter 7. The NRC's regulatory limits for radiological protection are set to protect workers and the public from the harmful health effects of radiation on humans. These radiation standards reflect extensive scientific study by national and international standards-setting organizations, and incorporate conservative assumptions and models to account for differences* *in gender and age to ensure that workers and all members of the public are adequately protected from radiation*.

D.2.2.12 Comments Concerning Accidents – Severe

Comment: The history of production of nuclear energy is replete with accidental threat of radiation exposure to human populations and to the environment (**0023-6** [Drake, Joan W.])

Comment: This location is within 50 miles of some 2.3 million people, including thousands of members of Sierra Club, both in North and South Carolina, who could be impacted by any serious nuclear incident at this facility (**0029-1** [Thomas, Bill])

Comment: And so it's not clean and it's not safe. I mean, anytime, you know, Chernobyl or some Three Mile Island accident could happen. (**0001-19-3** [Richards, Kitty-Katherine])

Comment: And you know what, if the Gulf oil spill has taught us anything, it's taught us that the worst case scenario can happen; it will happen eventually. We've been very lucky in this country that it hasn't happened. This community better get your evacuation plans well in hand and know where you're supposed to go. You better get your iodine pills and be ready. If nothing else, we've learned that complex systems can fail in complex ways that we can't even imagine. (**0001-30-10** [Corbett, Susan])

Comment: Catastrophic consequences of nuclear reactor failure come to mind i.e., Chernobyl and Three-Mile Island. (**0034-3** [Hallock, Judith])

***Response**: The comments concern the potential for severe accidents at the proposed Lee Nuclear Station. The environmental impacts of postulated accidents, including severe accidents, will be addressed in Chapter 5 of the EIS.*

D.2.2.13 Comments Concerning the Uranium Fuel Cycle

Comment: And then we need to disclose about the waste as well, because every form of power that uses fuel makes waste. In the case of uranium fuel, its waste that can cause cancer, birth defects, nobody wants it. And I'll go on record that western North Carolina does not want a granite repository, thank you very much. But I think it's time that the federal regulators that come out and talk to local communities about new waste generation happening in addition - you know, that's why you're going to withdraw all this water, is to cool that core to be sure that the nuclear meltdown doesn't happen. So, good, we're making waste, and so the regulator needs to disclose that the same regulator is considering changes its own regulations to make what is currently 120 years of temporary storage up to 300 years of temporary storage, because there is no plan for what to do with the waste that would be generated at the William States Lee site. So does the local community know that you are being sited with not only a pond and a nuclear

power plant but also a temporary storage site for waste up to 300 years.
(**0001-15-9** [Olsen, Mary])

Comment: there's also the question of waste. If the Lee station goes on line, it will be a high-level nuclear waste dump for the foreseeable future, and that's just the facts.
(**0001-23-3** [Hildebrandt, Lorena])

Comment: I'm worried about the waste. Barnwell is closing in 2038, so the waste that's generated here will not be able to go there after 2038. (**0001-30-5** [Corbett, Susan])

Comment: They've been kicking this nuclear waste can down the road for over half a century. They are no more equipped to deal with it now than they were when they started. They had to commission a blue-ribbon commission to study it again. It's ridiculous.
(**0001-30-7** [Corbett, Susan])

Comment: Nuclear waste is very dangerous, lasts for years and we have no where to store it because of NIMBY. (**0003-6** [Hale, Kendall])

Comment: Nuclear waste remains radioactive for millions of years; we still need effective nuclear waste management (**0013-3** [Thomas, Ellen])

Comment: William States Lee if it goes on-line will be a high-level nuclear waste dump for the foreseeable future. (**0014-5** [Olsen, Mary])

Comment: [Nuclear power …] produces hazardous and long lasting waste.
(**0017-3** [Hicks, Katie])

Comment: The permanent storage of radioactive waste remains unsolved regardless of the passage of federal legislation. (**0021-6** [Barnett, Barbara A.])

Comment: the difficulties entailed in managing toxic waste disposal from such production, all mitigate against the development of nuclear production and delivery services.
(**0023-4** [Drake, Joan W.])

Comment: The history of the production of nuclear energy is replete with extreme difficulty in designing, managing, and securing facilities and effective processes for the disposal of toxic waste. (**0023-7** [Drake, Joan W.])

Comment: There is still no resolution of the issue of safe disposal of long-lived hazardous nuclear waste from reactors in our nation, meaning that radioactive wastes will be stored on site as at other nuclear plants, adding to the hazards of the reactors themselves; and (An NRC study in 1997 calculated a fire in a spent fuel pool could produce 54,000 to 143,000 cancer deaths and would render 2,000 to 70,000 square kilometers of Agricultural Land uninhabitable. (Caldicott, Nuclear Power is not the Answer, p.99-105)) (**0029-2** [Thomas, Bill])

Comment: In the broader picture, I am concerned with nuclear power production related to uranium mining and the high-level nuclear waste production and storage. (**0034-2** [Hallock, Judith])

Comment: There is still no good plan for disposal of the radioactive waste that we already have let alone the waste from additional nuclear facilities. (**0037-2** [Breckheimer, Steve])

Comment: Nuclear power reactors create plutonium which can be used to make bombs. It is one of the most toxic man-made substances known, remaining radioactive for more than 240,000 years (**0013-6** [Thomas, Ellen])

***Response**: These comments concern the disposal of both low- and high-level radioactive waste, and the consequence of closing the Barnwell, South Carolina, low-level radioactive waste disposal facility. The impacts of the uranium fuel cycle, including interim storage and ultimate disposal of spent fuel and other radioactive waste, will be discussed in Chapter 6 of the EIS.*

Comment: Uranium mining does create a lot of pollution in itself, and it's getting harder and harder to mine good stuff, so it costs more and more, and the processing of it, the mining of it, the transportation of it -- it's not clean. Obviously it does have a lot of radioactive waste that we have to deal with for hundreds of thousands of years with deformed children and babies and cancer and all this kind of stuff. (**0001-19-2** [Richards, Kitty-Katherine])

***Response**: The comment concerns the potential for health impacts from radiation exposure from uranium mining. The impacts related to the uranium fuel cycle will be addressed in Chapter 6 of the EIS.*

Comment: And, you know, when President Obama, who has tried to do some good things for the country, you know, I think, but when he keeps saying that nuclear waste is going to be recyclable -- you know, they're going to make sure that they can find a way to do that -- you know, let's keep speaking out and saying, Where's your proof? You know, where have you got this genius scientist that has come up with a way? -- because it's not in existence. (**0001-19-4** [Richards, Kitty-Katherine])

***Response**: The comment concerns the potential for recycling spent nuclear fuel. The potential environmental impacts of the fuel cycle from recycling only the uranium from spent nuclear fuel will be addressed in Chapter 6 of the EIS. Recycling uranium and plutonium from spent nuclear fuel will not be addressed in the EIS. While Federal policy no longer prohibits recycling,* *additional research and development is needed before commercial recycling of spent fuel produced by U.S. nuclear power reactors occurs.*

Comment: There is no reduction in the carbon footprint, as far as I can tell, when we consider the entire life cycle of the project, from construction, permitting, mining, cooling, and disposing of waste. (**0001-20-5** [Bliss, Rachel])

Comment: We came here to talk about Make-Up Pond C, but we're really talking about the environmental impacts of the Lee nuclear plant as well. As we all know, fission -- the fission reaction directly does not involve carbon. A lot of people have been talking about nuclear as a carbon-free alternative, and a lot of people have been talking about that it's not carbon free. The fact is that it's not carbon free. It uses processes that use carbon. (**0001-22-3** [Fair, Gabriel])

Comment: An analysis of the entire nuclear fuel cycle, the entire cycle, from exploration to decommissioning and storage, the whole thing, is highly carbon intensive. It has a huge carbon footprint, but they only count the footprint while they're operating the plant, when they turn the key and operate that -- well, we'll just start counting it -- I mean, if you had a Land Rover and you drove to the top of Pikes Peak in Colorado and coasted into the valley and then looked at your gas mileage, you'd say, Hey, this thing's getting 200 miles to a gallon. Well, that's what the nuclear industry's doing. (**0001-25-2** [Richardson, Don])

Comment: There is no reduction in the carbon footprint when we consider the entire life cycle of the project from construction, mining, cooling and disposing of waste. (**0009-7** [Bliss, Rachel])

Comment: While nuclear plants in operation do not themselves release carbon dioxide or other Greenhouse gases contributing to the scientific expectations of global warming, they are not carbon neutral, as the mining and purification of uranium-derived fuels does produce these gases; (**0029-5** [Thomas, Bill])

Comment: Uranium mining is highly toxic, and so are processing and reprocessing. The reprocessing which nuclear advocates may argue makes it renewable, produce obscenely toxic chemicals along with the electricity, horrific bi-products which somehow must be hidden for hundreds of centuries, or at least until some genius discovers how to harmlessly neutralize radiation and toxic chemicals, which may take a very long time. All of these activities have a serious carbon footprint, so the allegation that nuclear power is clean is untrue. (**0013-7**, **0038-6** [Thomas, Ellen])

***Response**: These comments concern the greenhouse gas emissions of the entire fuel cycle and operation of the proposed Lee Nuclear Station. The impacts of greenhouse gas emissions from the life-cycle of fuel production, construction, operation, and decommissioning of the units will be presented in Chapters 4, 5, and 6, and in an Appendix of the EIS.*

Comment: The study that I am familiar with was written by Jan Willem Storm van Leeuwen, a Dutch engineer, and the late Philip Smith, an American engineer. They concluded that a small amount of net energy can be gotten from nuclear power by using the highest-grade ores. But of course we used the highest-grade ores first, and they're running out.

There may be no net energy using low-grade ores, but the industry keeps alive, because there's support for the spinoff of bomb materials; in other words, the production of things that we can't sanely use. (**0001-25-3** [Richardson, Don])

Comment: But when you think about it, uranium really comes from Russia and Kazakhstan and Canada. The kind of uranium we have in this country is very low grade and requires a lot of enrichment and is expensive and stuff like that; plus they made a huge mess uranium mining out west. (**0001-30-2** [Corbett, Susan])

Comment: Nuclear Power is not renewable. Uranium mining is highly toxic and needs to be imported from foreign countries. Again, creates dependency for the USA (**0003-2** [Hale, Kendall])

Comment: [Uranium is ...] imported from foreign countries. (**0013-8** [Thomas, Ellen])

Comment: Further, an analysis of the entire nuclear cycle, done by Jan Willem Storm van Leeuwen and the late Philip Smith, concluded that a small amount of net energy can be gotten from nukes by using the highest grade ores-which are running out-and that there may be NO net energy from the remaining low-grade ores. (**0015-3** [Richardson, Don])

Comment: Uranium itself is a finite resource like coal and oil, so nuclear power is not a sustainable energy source for the long term, like solar and wind-based energy sources (**0029-4** [Thomas, Bill])

***Response**: These comments concern the availability of uranium to fuel the proposed Lee Nuclear Station. The irretrievable and irreversible commitment of resources, such as uranium, will be addressed in the context of the availability of the resource in Chapter 10 of the EIS.*

D.2.2.14 Comments Concerning Transportation

Comment: The transportation of radioactive materials, fuels and waste, to and from the site is itself a hazardous activity subjecting the surrounding population along the transportation routes to health hazards from any accidents and radiation releases (**0029-3** [Thomas, Bill])

***Response**: The radiological and nonradiological impacts of transporting unirradiated fuel, spent nuclear fuel, and radioactive waste to and from the proposed Lee Nuclear Station and alternative sites will be addressed in Section 6.2 of the EIS.*

D.2.2.15 Comments Concerning Decommissioning

Comment: Where will they decommission this reactor? What will they do with it? Chances are this community will get stuck with it. (**0001-30-6** [Corbett, Susan])

***Response**: Title 10 CFR 50.75 requires the applicant to provide reasonable assurance that funding will be available for decommissioning activities at the time it is needed. The environmental impact of decommissioning a permanently shutdown commercial nuclear power reactor will be discussed in Chapter 6 of the EIS. In addition, NRC staff may consider information from Supplement 1 to NUREG-0586 (NRC 2002), Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, published in 2002, when analyzing the expected impacts of decommissioning.*

D.2.2.16 Comments Concerning Cumulative Impacts

Comment: Duke Power and SCE&G are planning to build a coal-fired plant, Cliffside, and 5 Nuclear Reactors on the Broad River. (**0003-7** [Hale, Kendall])

Comment: As the NRC is aware, Duke already operates five reactors here in SC and several more nearby in NC. In fact, SC is the most nuclear power reliant state in the SE and the 3rd most reliant in the country. Further, a host of nuclear waste and nuclear industrial operations are here in SC. The Savannah River Site near Aiken is the most radioactive Department of Energy site in the nation. The Barnwell nuclear dump is also a radioactive hot spot. Nowhere in the application does it discuss the cumulative impacts of having all these facilities operating in SC. Nor does it discuss the cumulative health impacts to Carolinians. The NRC must address these cumulative impacts to water resources and human health if it is to make a truly informed decision on adding two more reactors into this already radioactive mix.
(**0011-13** [Hancock, Mandy])

Comment:

- The National Environmental Policy Act EXPLICITLY recognizes "truncation" as a key issue when it comes to the potential for federal actions to negatively impact our environment - that the integrated totality of federal activity must be assessed - not just in pieces that exclude the larger picture
- On what basis does the Federal Regulator justify holding a scoping hearing on TWO power plants that are but 1/3 of the projected federally licensed powers plants to be impacting the Broad River? Six power plants: Cliffside, Summer x 3 and William States Lee x 2 are all in licensing actions now. Why is there no process that will assess ALL of those impacts - cumulative, synergistic and additive? (**0014-1** [Olsen, Mary])

Comment: In fact, South Carolina is the most nuclear power reliant state in the Southeast and the third most nuclear-reliant in the country, with about 58% of its electricity produced by nuclear power. Nowhere in the application does it discuss the cumulative impacts of having all these facilities operating nor does it discuss the cumulative health impacts to Carolinians.
(**0030-9** [Barczak, Sara] [Hancock, Mandy])

***Response**: Cumulative impacts result from the combined effects of the proposed action and past, present, and reasonably foreseeable actions, regardless of who takes the actions. The appropriate geographic area and time period for considering cumulative impacts depend on the resource being affected and will be determined for each resource as part of the review team's evaluation. The impacts of building and operating the proposed Lee Nuclear Station on the Broad River and adjacent lands would be added to other known or reasonably foreseeable actions and stressors within the defined geographic area of interest. The results of cumulative impact analyses will be presented in Chapter 7 of the EIS.*

Comment: And the revised report doesn't even consider the future implications of climate change. (**0011-10** [Hancock, Mandy])

***Response**: The cumulative impacts analysis contained in Chapter 7 of the EIS will also include the potential effects of global climate change.*

D.2.2.17 Comments Concerning the Need for Power

Comment: As a high-growth state, South Carolina needs additional safe and reliable electricity. As serving as a member of the delegation of the local county development board, that's one of the big questions: Can we provide infrastructure and electricity for people that are desiring to move to South Carolina to provide jobs for our citizens. (**0001-1-1** [Moss, Dennis Carroll])

Comment: The growing need of energy to power our own world is becoming more and more important every day. The 2234 megawatts of power Lee Nuclear Station will generate can and will go a long way in meeting energy needs of the future. (**0001-13-1** [Boger, Paul])

Comment: If we are to sustain the economic healing of plants devastated by the recession, encourage the expansion of those in other facilities, and attract more new plants and the high-paying jobs that they bring with them, we must have the infrastructure to support their operations. First and foremost on that list of essential infrastructure is energy. Traditional industries like paper, textile, and chemistry are well known for their energy consumption. South Carolina now has significant automotive, aviation and advanced materials operations. All of these industries have fantastic potential for future growth in the state, and all are heavy energy users. As manufacturing companies decide to locate or expand in the state, they will need assurances about the availability and reliability of energy.
(**0001-14-2** [Hopper, Sara])

***Response**: These comments express general support for additions to new electric generating capacity in North Carolina and South Carolina such as the proposed Lee Nuclear Station. However, these comments provide no new information relevant to the environmental review and will not be addressed in the EIS.*

Comment: Further, the NRC needs use updated information to reevaluate Duke's analysis for the new reactors in terms of the need for power given the economic downturn and reduction in demand. (**0011-6** [Hancock, Mandy])

Comment: Additionally, the NRC needs to consider all of Duke's new power plant proposals, such as the new coal unit proposed for the Cliffside plant in North Carolina and how that affects the need for the proposed new reactors. (**0030-4** [Barczak, Sara] [Hancock, Mandy])

Comment: The base load estimates to justify the building of these units is flawed. With a little bit of effort from the government and Duke Power, we could reduce power consumption and avoid having to build two expensive and potentially dangerous power plants.
(**0037-1** [Breckheimer, Steve])

***Response**: Affected states or regions may prepare a need for power evaluation and an assessment of the regional power system for planning or regulatory purposes. In North Carolina and South Carolina, the need for power analysis may also be prepared by a regulated utility company and submitted to a regulatory authority, such as a state Public Utilities Commission (PUC). This analysis, called the Integrated Resource Plan (IRP), contains details on energy efficiency, demand-side management, and peak power reduction strategies, all of which are considered conservation activities. The state PUC also has regulatory authority over issuance of the Certificate of Public Necessity and Convenience, as well as rates and rate recovery regarding the construction and operation of new power plants. Duke submitted its most recent IRP to both North Carolina and South Carolina in September 2011 (ADAMS Accession No. ML11262A205) (Duke 2011), and accounted for the Cliffside Station in out-year capacity and margin projections. When another agency has the regulatory authority over an issue, the NRC defers to that agency's decision. The NRC staff will review the need for power and determine if it is (1) systematic, (2) comprehensive, (3) subject to confirmation, and (4) responsive to forecasting uncertainty. If the need for power evaluation is found to be acceptable, no additional independent NRC review is needed. Need for power will be addressed in Chapter 8 of the EIS and alternative energy supply options will be further evaluated and addressed in Chapter 9. The information provided in these comments will be considered to determine whether it significantly affects the forecast upon which Duke relied for its need for power analysis.*

D.2.2.18 Comments Concerning Alternatives – Energy

Comment: And I understand the local community wants benefits, but I'm here to say that you could get three to four times more benefit through instituting a truly green non-nuclear energy base here. The job numbers are spectacular around the world for the development of non-nuclear renewal energy, and also energy efficiency which is delivered; not just telling people to change their light bulbs but actually going into homes and helping people with stopping the leaks of their insulation, putting in additional -- better windows, better insulation, better light bulbs, upgrading appliances. The whole wad is a number of issues around how we're spending our money, how we're making our jobs and what the quality of life is. (**0001-15-6** [Olsen, Mary])

Comment: Conservation of energy is the best solution to our energy needs. Energy use has decreased in recent years, especially in the Asheville area, and we see, as conservation takes hold -- I don't believe any new plants will be needed. (**0001-20-4** [Bliss, Rachel])

Comment: If we're going to provide new energy plant to meet the needs of the future citizens of South Carolina, we need to consider the needs for renewable energy. (**0001-22-1** [Fair, Gabriel])

Comment: Ladies and gentlemen, we South Carolinians face a crisis. That crisis is ignorance, ignorance to our need to avert -- or invest, rather, in energy efficiency and alternative sources.

South Carolina is 25th in population but 19th in energy consumption per capita. To put that into perspective, California, which is the most populous state in the Union, is 47th in energy per capita, and yet they still use a lot, but we are using far more per capita. New York, which has the largest city in the country, is 27th. (**0001-24-1** [Swinton, D.C.])

Comment: People often praise nuclear energy on - as our savior from fossil fuels: a clean, efficient source. However, it's nowhere close to efficient and is ridiculously costly.

Both boiling-water reactors and pressurized-water reactors, which is the one that Lee county would be -- or Lee Nuclear Station would be, rather, only run at 33 percent efficiency.

The site would have to tap into other plants in the area for energy in the event of an emergency, increasing the strain on those plants, which also happen to run around 33 percent efficiency. Add on top of that our decrepit electrical transport grid, and you have one big ball of waste -- wasted energy, that is. (**0001-24-4** [Swinton, D.C.])

Comment: Other alternative means of power generation can be brought on line in less time, provide many more construction jobs for many more companies, and are less risky, do not require large taxpayer liability subsidy, and do not hold a threat to my health, your health, and ecological health posed by operation of nuclear plants and centuries or more of storing toxic radioactive waste. (**0001-27-1** [Howarth, Robert F.])

Comment: Another compelling reason for my opposition to any more construction of nuclear power plants is well illustrated by comparing them to other available functional and healthier means of electrical power generation, comparison in terms of EROEI. That a new one for you? That is energy return for energy invested. This comparison reveals that nuclear is number 15 out of 20 candidates that are currently available. There are 15 -- this means that there are 14 available sources more desirable than nuclear energy in terms of overall efficiency. I have a source for that, and it's listed here.

That is -- this overall energy -- this overall efficiency assessment includes and is composed of a whole system consideration from the extraction at the source, processing, construction, operation of the delivery plant, and cost of any subsequent waste handling and/or disposal. (**0001-27-2** [Howarth, Robert F.])

Comment: And what irks me is that right up the road in Greenville we have a perfectly good GE wind turbine plant making huge wind turbines, and right off our coast we have a DOE-certified 4 million watts of offshore wind-power potential, just sitting there waiting for us to use our amazing Charleston port as a staging ground for the eastern coast wind farm.

Why aren't we doing this? They are doing this -- I just drove to Chicago two weeks ago for a nuclear waste summit, and on the way I drove through Lafayette, Illinois -- Indiana. It was amazing. I didn't know it was there; it just suddenly appeared on the horizon. It was hundreds of wind turbines, really as far as the eye could see. And it was in pasture, and there were cows grazing, and it was amazing. They were just turning very slowly. I don't know how much power. I went to go home and Google that; I never figured it out. But they're doing it in other places, and we keep talking about, well, we're going to research this, we're going to research it. We just need to do it.

And the same thing with solar. I mean, we have 300 sunny days in this state, you know? (**0001-30-4** [Corbett, Susan])

Comment: When alternatives exist that would provide energy in safer, cleaner and more sustainable ways, that would provide jobs and leave our children and our children's children a safer, cleaner future, why is nuclear energy even being considered? (**0008-3** [Craig, Anne])

Comment: Conservation of Energy is the best solution to our energy needs. Energy use has decreased in recent years and we see as conservation takes hold, no new plants will be needed. (**0009-4** [Bliss, Rachel])

Comment: If the NRC could be concerned with the pocket books of the American people (probably not your Department either), it would be looking at the economic benefits of production-based-incentives for distributed customer-supplied solar energy so rapidly successful in cloudy Germany, several US municipalities, Ontario, Canada and spreading world-wide. The truth is nuclear energy in its current form is NOT the solution to US sustainable, renewable, clean energy needs. (**0010-7** [Arnason, Deb])

Comment: Utilities in South Carolina have more affordable ways to meet the region's increasing demand for energy while protecting our water resources and tackling global warming. Promoting energy efficiency measures and investing more resources in the region's wind, solar, and bio-energy industries instead of costly new reactors would benefit Duke Energy and offer economic development opportunities for the region, without draining our water resources or pocketbooks. The NRC must evaluate updated information on using a combination of these alternatives that are far less water intensive before allowing Duke Energy to commit billions of dollars, billions of gallons of water, and nearly an entire decade or more to building these reactors when that time and money could be better spent on less risky, more sustainable energy choices. (**0011-3** [Hancock, Mandy])

Comment: Energy efficiency measures preserve our water resources, save consumers money and also pose no health or safety risks to the public. South Carolina utilities have significant resources to tap in these areas as outlined in a recent extensive report, Energy Efficiency in the South, by Georgia Tech and Duke University 1 and our report, Yes We Can: Southern Solutions for a National Renewable Standard. (**0011-4** [Hancock, Mandy])

Comment: Renewable energy technologies, such as solar and wind, do not require extreme manipulation of our precious water resources. The revised Environmental Report still overlooks Duke's excellent wind resources within its service territory. The Clemson University Restoration Institute shows that South Carolina is poised to lead the charge toward renewable offshore wind energy with its high offshore wind capacity and to reap large economic benefits from the manufacture of wind turbines. The NRC must evaluate a combination of energy efficiency, wind, solar, and clean bio-energy sources as a viable alternative to building expensive and risky new reactors. (**0011-5** [Hancock, Mandy])

Comment: When comparing types of energy generation, nuclear power has higher rates of both water withdrawal and consumption than coal and natural gas and far more than renewable energy sources, such as wind and solar. An April 2010 report by the Georgia Institute of Technology and Duke University examined energy efficiency in the South and illustrated ways by which we could substantially reduce our energy needs, while simultaneously reducing our water consumption. According to the report: In the North American Electric Reliability Council (NERC) regions in the South, 8.6 billion gallons of fresh water could be conserved in 2020 (56% of projected growth in cooling water needs) and in 2030 this could grow to 20.1 billion gallons of conserved water (or 45% of projected growth). (**0011-8** [Hancock, Mandy])

Comment: Other alternative means of power generation can be brought on line in less time, provide many more construction jobs for many more companies, are less risky, do not require large taxpayer liability subsidy, and do not hold the threat to my health, your health, and ecological health posed by operation of nuclear plants and centuries of storing toxic radioactive wastes. (**0012-2** [Howarth, Robert F.])

Comment: Meanwhile, cheaper, safer, job-rich and quicker alternatives are already growing exponentially as nuclear power fades away, and none of them is a terrorist target. They're decentralized and thus protected from failure. They are outperforming nukes every day. (**0015-2** [Richardson, Don])

Comment: [Nuclear power …] cannot be built fast enough to be an effective climate solution in the short term. Cheaper, safer, more just alternatives - such as energy efficiency and conservation, solar, and wind - are a wiser investment. (**0017-5** [Hicks, Katie])

Comment: In Western NC we have plentiful opportunities for energy efficiency and conservation, wind, and solar power. There is no need for such an unstable, expensive and water-intensive project. I urge you to investigate all the viable possibilities and not to permit these new reactors. (**0017-7** [Hicks, Katie])

Comment: I also trust current comprehensive energy plans consider new energy generation in balance with reasonable implementation of reductions in energy consumption. Therefore, I encourage regulators to strongly recommend that comprehensive plans for new plants include consideration for incentives to encourage off-peak use, such as a significant reduced rate offering for off-peak residential uses (a profound positive initiative for seniors and other factions of the low income/unemployed facing uncertain economic futures as it reduces residential consumption during peak hours ...). (**0019-3** [Mominee, Katharine N.])

Comment: I am also interested in the direction for renewable resources on the horizon. Rather than wind, is tidal energy under serious investigation? (**0019-4** [Mominee, Katharine N.])

Comment: Nuclear power is a very costly enterprise, in fact, nuclear power would cost twice as much as renewable energy sources , e.g., solar, wind and geothermal power. (**0021-1** [Barnett, Barbara A.])

Comment: The NRC must evaluate these alternatives more thoroughly before allowing Duke Energy to commit the billions of dollars, millions of gallons of water, and nearly an entire decade to building these proposed reactors when that time and money could be better spent on less risky, more sustainable solutions. (**0030-2** [Barczak, Sara] [Hancock, Mandy])

Comment: Duke's Environmental Report overlooks the excellent wind resources within its service territory. The Clemson University Restoration Institute shows that South Carolina is

poised to lead the charge toward renewable offshore wind energy with its high offshore wind capacity and to reap large economic benefits from the manufacture of wind turbines. Wind, solar, clean bio-energy sources, and efficiency should be fully employed before building expensive and risky nuclear reactors. The NRC should evaluate the use of a combination of these energy choices in comparison to the proposed new reactors.
(**0030-3** [Barczak, Sara] [Hancock, Mandy])

Comment: Duke Energy and its utility partners can meet demands using less water-intensive, affordable energy options. When comparing types of energy generation, nuclear power _has higher rates of both water withdrawal and consumption than coal and natural gas and far more than renewable energy sources, such as wind and solar. For example, according to the Department of Energy's National Renewable Energy Laboratory, developing just 1000 MW of wind in neighboring Georgia instead of traditional power plants could save 1628 million gallons of water per year. (**0030-8** [Barczak, Sara] [Hancock, Mandy])

Comment: Why not spend the money on conservation and appropriate alternative energy and invest in a safe future for our children and grandchildren? (**0034-4** [Hallock, Judith])

***Response**: The NRC does not establish or comment on public or private policy regarding electric power supply alternatives, nor does it promote the use of nuclear power as a preferred energy alternative. Decisions regarding which generation sources and alternatives to generation sources to deploy are made by Duke through least-cost planning and integrated resource plans. Additional regulatory purview is provided by bodies such as State energy-planning agencies, PUCs, and through State legislative actions. The discussion of various energy alternatives to the proposed project is pertinent to the extent that an energy alternative must reasonably be expected to meet the need for power as proposed (including the need for baseload power), whether singly or in combination. The alternatives must be technically viable and feasible. Chapter 8 of the EIS will include review of the need for power in the service territory including the impacts of demand-side management and energy efficiency on the load forecast. Chapter 9 will include the no-action alternative (i.e., denial of a COL), energy conservation and efficiency, demand-side management, new generation alternatives, purchased electrical power, alternative energy technologies (including renewable energy such as wind, solar, and biomass), and the combination of alternatives. In addition, NRC staff is cognizant that information representative of current technology must be considered. For acceptable alternatives, the potential for environmental impacts will be assessed against that of the proposed project.*

Comment: To create renewable energy sources, that would use carbon as well; however, the carbon in those is not -- is -- the carbon that is used in the Lee nuclear plant is -- from the start to the finish will be using carbon, and it's risky. (**0001-22-4** [Fair, Gabriel])

Comment: Furthermore, comparison in terms of carbon footprint shows nuclear as having the third highest among these candidates, following only conventional coal and tar sands. It has a huge carbon footprint when you look at the whole ball of wax, the whole picture, which as I said I believe is the honest way to look at it. (**0001-27-3** [Howarth, Robert F.])

Comment: In the current crisis to provide energy to meet our future needs, we demand that utilities utilize technologies to create an energy system that does not devour economic, environmental, and water resources. The inherent power in the Earth's environmental systems along with measures to reduce overall energy demand can provide the energy needed without degrading ecosystems and depleting life-necessary resources. There is an opportunity to do things differently and in smarter, non-radioactive ways. That opportunity must be seized for the sake of our communities and future generations. (**0011-14** [Hancock, Mandy])

Comment: 350 parts per million is considered the safe upper limit of C02 in our atmosphere. We are now at 392. Getting back to 350 means transforming our world. It means building solar arrays instead of coal plants, it means conservation is no longer the last resort, it means planting trees instead of clear-cutting rainforests, it means increasing efficiency and decreasing our waste. Getting to 350 means developing a thousand different solutions-and most of them will demand money. (350.org) (**0016-6** [LeVander, Valerie])

Comment: It is very important that we reduce our dependency on foreign oil as quickly as possible. (**0018-2** [McCall, Pat])

***Response**: The NRC is not involved in establishing energy policy; rather, it regulates the nuclear industry to protect public health and safety within existing policy. As part of its review of COL applications for new nuclear power plants under NEPA, the NRC does evaluate energy alternatives. Chapters 4, 5, 6, and 7 will include a review of the impacts associated with the construction and operation of the proposed Lee Nuclear Station, including an evaluation of carbon-based greenhouse gas emissions. The discussion of alternative energy sources in Chapter 9 of the EIS will describe the potential environmental impacts from alternative energy sources, including estimated emissions of greenhouse gases, and provide an analysis of energy efficiency and renewable energy sources.*

Comment: Well, why would we look to the nuclear industry to create more jobs? It's probably the most job-poor industry in the United States. That's when you start looking at your alternative energies, which are going to hire millions of people. This is a labor-intensive industry. Renewable energy is labor-intensive; nuclear isn't. (**0001-25-6** [Richardson, Don])

Comment: [production-based incentives for distributed customer-supplied solar energy] creates more jobs than you'll ever see from Duke Energy; they can't fill all the jobs in Ontario, and I've been to Gainesville, and I know what they're able to do there. And the economy is just booming there, too. (**0001-6-1** [Arnason, Deb])

***Response**: The NRC does not establish public policy regarding electric power supply alternatives, nor does it promote the use of nuclear power as a preferred energy alternative. Decisions regarding which generation sources and alternatives to generation sources to deploy are made by Duke through least-cost planning and IRPs. The socioeconomic impacts of construction and operation of the proposed Lee Nuclear Station, including both job creation and job retention, will be addressed in Chapters 4 and 5 of the EIS. Job creation and retention for alternative energy technologies will not be addressed in the EIS.*

D.2.2.19 Comments Concerning Alternatives – System Design

Comment: A nuclear plant must have lower thermodynamic efficiency than even a coal-fired or any other fossil-fuel type plant. There's been a lot of concern about coal-fired power plants at Cliffside and elsewhere. That is, if a coal plant and nuke plant produce the same output, electrical, the nuke plant will create about 30 percent more waste heat discharged into the river.

This is because it is impossible to create superheated steam inside a nuclear reactor core using boiling or pressurized water for both moderator and heat transfer. Hot steam from burning coal or oil that turns a turbine in a fossil plant may be heated to nearly 2000 degrees before it gets to the turbine. This is called superheated or dry steam.

The best a nuke can do is much less than a thousand degrees and creates what is called saturated wet steam. So the best possible efficiency for a nuclear plant is about 30 percent lower than in a fossil-fuel plant. What does that mean for the present situation?

Well, in March the New York State Department of Conservation released a draft policy calling for power plants and other facilities that use water for cooling to recycle and reuse water through closed-cycle cooling technology. That rule would affect six nuclear reactors in New York State, which may require some $2 billion investments in order to continue operating.
(**0001-9-3** [Zeller, Lou])

***Response**: The Energy Information Administration (EIA) lists the average operating heat rates for the following technologies: coal, natural gas, petroleum, and nuclear. Information available from the EIA website indicates that the coal and nuclear technologies have very similar energy efficiencies as measured by heat rate (i.e., coal [10,378 btu/kwh] and nuclear [10,455 btu/kwh]). However, because fossil-fired plants are capable of running higher turbine inlet pressures, their thermal efficiencies are higher than a nuclear power plant. For example, where a nuclear power plant may operate at 32 percent thermal efficiency, supercritical coal-fired power plants can operate at 40 to 43 percent thermal efficiency, while natural-gas-fired combined-cycle power plants may operate at 57 to 59 percent thermal efficiency. Steam-turbine metallurgy in any cycle configuration is currently limited to approximately 600°C (1112°F) at the turbine inlet. Information regarding alternative system configurations, including alternative cooling* *configurations, will be addressed in Section 9.4 of the EIS. The EIA webpage can be accessed at http://www.eia.doe.gov/cneaf/electricity/epa/epat5p3.html.*

D.2.2.20 Comments Concerning Benefit-Cost Balance

Comment: The Lee Nuclear Station will benefit our state by creating construction jobs, stimulating the local economy through service jobs, provide low-cost, safe, reliable carbon-free electricity to our citizens. (**0001-1-3** [Moss, Dennis Carroll])

Comment: The facility in Cherokee County will bring billions of dollars in investment to our state, create thousands of good-paying jobs for our citizens, produce reliable energy for our businesses, and, importantly, produce it cleanly and safely in a carbon-free manner (**0001-10-5** [Scott, Darrell])

***Response**: These comments express general support for the proposed Lee Nuclear Station and imply that nuclear power plant emissions contain less carbon than other generation alternatives. Emissions from plant construction and operation will be evaluated in Chapters 4 and 5 of the EIS. Emissions from the uranium fuel cycle will be evaluated in Chapter 6. Emissions from power generation alternatives will be evaluated in Chapter 9 of the EIS. Socioeconomic impacts on the local economy through jobs will be discussed in Chapters 4 and 5 of the EIS. Benefits of the proposed project will be discussed in Chapter 10 of the EIS.*

Comment: This site was under construction 30 years ago and subsequently canceled. It was canceled for economic reasons. Duke is currently in a situation where they don't have funding for this site; otherwise they wouldn't be having secret meetings with North Carolina legislators about changing North Carolina law in order to reach into the pockets of their customers in western North Carolina to pay for this thing. So what is the guarantee that you're not looking at a NEPA process where you're going to look at an action alternative that has absolutely no benefit -- high impact and no benefit. That's what it had 30 years ago; that's what it could have now. (**0001-15-4** [Olsen, Mary])

Comment: Providing this plant is not a good way to use money. This is a sink of the ratepayers' money, and it will only invest in a form of energy which is finite and which comes with risks. (**0001-22-2** [Fair, Gabriel])

Comment:

- Why is NRC proceeding with this review when it is CLEAR that Duke is lacking funding for this project? It is reported that Duke is having secret meetings with "leaders" in the NC State legislature -because it must CHANGE NC LAW in order to get the money for this project.

- Duke requires DELEGATED TAXATION for the construction of this site - effectively collecting money from its customers that is not fee for service and will NOT be refunded if the site in Cherokee County is canceled for a second time (**0014-7** [Olsen, Mary])

Comment: Duke Energy wants permission to transfer the cost of building the nuclear power plants to electricity customers BEFORE the plants ever go online. This will increase electricity costs for years to come. And it is not inconceivable that the plant never will go online, as happened in Gaffney with the Cherokee plant in the 1980's. (**0038-4** [Thomas, Ellen])

***Response**: The NRC's responsibility is to regulate the nuclear industry to protect public health and safety within existing policy. The NRC is not involved in establishing the rates paid by customers. Comments regarding funding and electricity rates will not be addressed in the EIS, however, the Benefit-Cost Balance section of Chapter 10 will discuss the costs of preconstruction, construction, and operation of two nuclear units at the Lee site.*

Comment: And they have to use all this federal money, loan guarantees, and this is the thing about these loan guarantees. Yeah, it's a loan. But if they do what they did last time and leave 64 plants unbuilt, when they default this time, you and I are stuck with the bill. If they default, the taxpayer gets stuck, not the investor. (**0001-30-9** [Corbett, Susan])

Comment: Building new nuclear power plants cost 6-8 billion dollars/reactor. With guaranteed government bail-outs; Which means my tax dollars! (**0003-1** [Hale, Kendall])

Comment: Nuclear power is capital intensive and funding is elusive because financial investors find nuclear power a very risky venture, as does the insurance industry who will not indemnify them, therefore, the only alternative is government subsidies. (**0021-2** [Barnett, Barbara A.])

Comment: The cost of nuclear power is high relative to other sustainable technologies when the safety, environmental and legal liability costs are factored in, (as demonstrated by the failure of private investors to fund such plants without government subsidies and liability caps. (**0029-7** [Thomas, Bill])

***Response**: The NRC is not involved in establishing national energy policy, and issues related to the subsidization of nuclear power are outside the scope of the NRC's mission and authority. A description of the benefits and costs of the proposed project will be provided in Chapter 10 of the EIS.*

Comment: You construct Pond C and it never generates any electric power because people rise up in North Carolina and realize that energy efficiency and non-fuel-based energy technologies are the way to go and refuse to pay. (**0001-15-5** [Olsen, Mary])

Comment: So, do we spend billions on this nuclear plant or do we spend billions on saving this planet. (**0016-7** [LeVander, Valerie])

***Response**: Alternatives to the proposed Lee Nuclear Station will be discussed in Chapter 9 of the EIS. Costs will be discussed in Chapter 10 of the EIS.*

Comment: So these are things in scoping that must be considered and weighed along with the construction of that pond. Is any power going to be generated here that might be construed as a benefit versus the very large impacts to this area by creating that pond?
(**0001-15-10** [Olsen, Mary])

Comment: Building another plant may decrease the cost of energy to consumers years down the road, but at what cost? -- the severe alteration of the Broad River via water intake and thermal pollution, creating dead zones of aquatic life; the creation of tons of nuclear waste that only will be stored in South Carolina? (**0001-24-2** [Swinton, D.C.])

Comment: A report released -- the proposed site area cannot sustain these proposed nuclear reactors without enormous strain placed on our rivers, environment, and ratepayers, not to mention the taxpayers' money. Besides the environmental irresponsibility of Duke Energy in proposing nuclear reactors in a drought-prone area, there's fiscal irresponsibility, especially in this recession. (**0001-23-4** [Hildebrandt, Lorena])

Comment: Who is doing the modeling for this project? Are those who are responsible for modeling the feasibility of this project going to also profit if this project is approved?
(**0009-6** [Bliss, Rachel])

Comment: On what basis does the Federal Regulator stand here with a straight face talking about "benefit" to justify "cost" to the Broad River and other aspects of the Piedmont environment? (**0014-6** [Olsen, Mary])

Comment: We urge you to consider the many disadvantages of nuclear energy in your environmental impact assessment. Nuclear power is expensive. (**0017-2** [Hicks, Katie])

***Response**: The costs and benefits of the proposed Lee Nuclear Station will be discussed in Chapter 10 of the EIS.*

Comment: A report released in 2009 revealed the soaring costs of nuclear energy. The economics of nuclear reactors' renaissance or relapse reported that during the previous year, the cost estimates from new generation reactors can range to a high of 30 cents from a low of 8.4 cents per kilowatt-hour. In contrast, energy efficiency costs about 3 cents per kilowatt-hour.
(**0001-23-5** [Hildebrandt, Lorena])

Comment: It's not affordable. They're talking about 20 cents, and they're lying about it. My utility said it's going to cost us 7 cents a kilowatt hour; it's looking more like 20 cents, 25 cents, even, when they get it all built. (**0001-30-8** [Corbett, Susan])

Comment: Stop the proposal of William States Lee Nuclear Power Plant in Gaffney, SC., because:
1. Nuclear Power is Expensive, $6 to $8 billion per reactor; with promised bailouts from our government. (**0013-1** [Thomas, Ellen])

Comment: Another compelling reason for my opposition to any more construction of nuclear power plants is well illustrated by comparing them to other available, functional and healthier means of electrical power generation. Comparison in terms of EROEI, that is Energy Return For Energy Invested, reveals that nuclear is 15th out of 20 candidates (1). EROEI , also known as Net Energy, has been defined as the energy delivered by an energy-obtaining activity compared to the energy required to get it (2). That is, there are 14 sources more desirable than nuclear in terms of overall efficiency. This overall efficiency assessment includes a whole system consideration from the extraction at the source, processing, construction and operation of the delivery plant, and cost of any subsequent waste handling and/or disposal. This I believe is looking at the "whole picture" in the way it really is, in an honest way.
(**0012-4** [Howarth, Robert F.])

Comment: A new series of recent studies have found that the capital costs of new conventional atomic reactors have gotten so high that even before you factor in fuel and operations, you're talking seventeen to twenty-two cents per kilowatt hour-which is two or three times what Americans currently pay for electricity. (Joe Romm, Exclusive Analysis, Part 1: The Staggering Cost of New Nuclear Power, ClimateProgress.org, January 5, 2009) (**0016-3** [LeVander, Valerie])

Comment: The proposed Gaffney nuclear plant as well as other proposed nuclear plants will rob us of much needed capital to fund our shift to clean renewable energy. We have no more time to waste. (**0016-5** [LeVander, Valerie])

Response: *The NRC does not have authority under the law to ensure that the proposed plant is the least costly alternative to provide energy services under any particular set of assumptions concerning future circumstances. The potential for alternative non-nuclear technologies will be discussed in Chapter 9 of the EIS. The disclosure of the costs of the proposed action will rely on the best available estimate of financial costs with uncertainties noted. Associated costs that cannot be reliably quantified will also be discussed. The estimated overall internal and external benefits, costs, and associated environmental impacts of the proposed project will be addressed in Chapter 10.*

Comment: As an alumna of the UNC-Chapel Hill Gillings School of Public Health, my familiarity with the extraordinary cost burden to taxpayers of the development of nuclear production facilities mitigate against the development of nuclear production and delivery services. (**0023-2** [Drake, Joan W.])

***Response**: The NRC does not have authority under the law to ensure the proposed Lee Nuclear Station is the least costly alternative to provide energy services under any particular set of assumptions concerning future circumstances. This authority and responsibility is most often the role of State regulatory authorities. The potential for alternative non-nuclear technologies will be addressed in Chapter 9 of the EIS. The disclosure of costs of the proposed Lee Nuclear Station will rely on the best available estimate of financial costs with uncertainties noted. Associated costs that cannot be reliably quantified also will be discussed. The estimated overall internal and external benefits, costs, and associated environmental impacts of the proposed project will be addressed in Chapter 10 of the EIS.*

Comment: Nuclear power died of market forces many decades ago but the industry, ever the opportunist for public subsidies, these many years later still keeps insisting that we try again, ignoring the final diagnosis. In my view, the entire industry needs professional help. (**0015-1, 0001-25-5** [Richardson, Don])

Comment: Bottom line: building enough conventional nuclear reactors to eliminate a tenth of the threat of global warming would cost about $8 trillion, not to mention running electricity prices through the roof. You'd need to open a new reactor every two weeks for the next forty years and, as the analyst Joe Romm points out, you'd have to open ten new Yucca Mountains to store the dangerous waste. Meanwhile uranium prices have gone up by a factor of six this decade, because we're running out of the easy-to-find stuff and miners are having to dig deeper. (Bill McKibben, Eaarth,2010) (**0016-4** [LeVander, Valerie])

Comment: The history of the production of nuclear energy energy [sic] is replete with record levels of inordinate public expense (**0023-5** [Drake, Joan W.])

Comment: I believe investing millions of dollars required to bring on line a nuclear power plant is not a good investment. History demonstrates that cost always exceeds initial estimates, financing is dependent on government subsidy in the form of liability insurance, and the 5 to 10 year or more construction time is too long. (**0012-1** [Howarth, Robert F.])

***Response**: Issues related to costs associated with previous projects are outside the scope of the proposed action and will not be addressed in the EIS. The NRC is not involved in establishing national energy policy, and issues related to the subsidization of nuclear power are outside the scope of the NRC's mission and authority. The estimated overall costs and environmental impacts of the proposed project will be addressed in Chapter 10 of the EIS. The* *benefit-cost balance for the project will rely on the best available estimate of project timing and duration, while noting possible uncertainties that may affect those estimates.*

Comment: And I know that the nuclear reactor is more than just one blowout protector away from a meltdown, but it's still a complex system with multiple possibilities of failure, and there is a liability cap on it as well. There's an $11 billion liability cap, I believe, and I saw a recent study that showed that a major accident in a fuel pool could be $500 billion, and you and I, again would pay for that, because there's a liability cap. (**0001-30-11** [Corbett, Susan])

***Response**: The effects of accidents will be considered in both the environmental and safety reviews. Postulated accidents, including design-based and severe accidents, will be addressed in Chapter 5 of the EIS. The estimated overall costs and environmental impacts of the proposed project will be addressed in Chapter 10.*

Comment: We feel that the Lee nuclear site will give Duke a better portfolio to give us inexpensive power that we require to keep people employed in Cherokee County and flexibility to enable that. (**0001-7-2** [Ware, Steve])

***Response**: This comment expresses support for the proposed action. The costs and benefits of the proposed Lee Nuclear Station will be discussed in Chapter 10 of the EIS.*

Comment: Included among our reasons [for opposing this nuclear plant] is this major factor-cost. While others here will speak to important environmental factors such as water, transport, safety, toxicity and storage, we wish to address cost. Why? Because moving to renewable clean energy is going to cost a lot of money. We are going to have to make choices in how we spend our public purse. As many economists, scientists and industry leaders have noted, there will not be enough money to both build expensive nuclear plants and fund research and implementation of non polluting energy sources. (**0016-2** [LeVander, Valerie])

***Response**: Renewable energy resources will be considered in Chapter 9 of the EIS. The NRC does not have authority under its regulations to ensure the proposed Lee Nuclear Station is the least costly alternative to provide energy services under any particular set of assumptions concerning future circumstances. This authority and responsibility is most often the role of State regulatory authorities. Chapter 9 of the EIS will address the potential for alternative non-nuclear technologies to provide the electricity that could be generated by the proposed power plants and their environmental impacts. The benefits and costs of the proposed project will be discussed in Chapter 10 of the EIS.*

Comment: All costs are not included in the industry estimate of $11 billion, e.g., mining of uranium, transportation of uranium, enrichment plants, subsidy for construction, the temporary disposal of waste, the permanent disposal site, monitoring the Lee reactor, indemnifying the plant, dismantling and burial of the reactor. (**0021-3** [Barnett, Barbara A.])

***Response**: The NRC staff will evaluate the environmental impacts of the uranium fuel cycle including the impacts of fuel manufacturing, transportation, and the onsite storage and eventual disposal of spent fuel. The estimated overall costs and environmental impacts of the proposed Lee Nuclear Station project will be addressed in the EIS. The benefit-cost evaluation for the project, which will be included in Chapter 10, will rely on the best available estimates of project timing and duration, while noting possible uncertainties that may affect those estimates.*

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8. PERFORMING ORGANIZATION - NAME AND ADDRESS (If NRC, provide Division, Office or Region, U. S. Nuclear Regulatory Commission, and mailing address; if contractor, provide name and mailing address.)

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10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. NRC by Duke Energy Carolinas, LLC (Duke) for two combined construction permits and operating licenses (combined licenses or COLs). The proposed actions requested in Duke's application are (1) NRC issuance of COLs for two nuclear power reactors at the William States Lee III Nuclear Station (Lee Nuclear Station) site in Cherokee County, South Carolina, and (2) U.S. Army Corps of Engineers (USACE) permit action on a Department of the Army individual permit application to perform certain construction activities on the site. The USACE is participating with the NRC in preparing this EIS as a cooperating agency and participates collaboratively on the review team.

This EIS includes the review team's analysis that considers and weighs the environmental impacts of building and operating two new nuclear units at the proposed Lee Nuclear Station site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts. The EIS includes the evaluation of the proposed project's impacts on waters of the United States pursuant to Section 404 of the Clean Water Act.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)	
environmental impact statement, EIS, Duke, combined construction permits and operating licenses, combined licenses, COLs, nuclear power reactors, William States Lee III Nuclear Station, Lee Nuclear Station, Cherokee County, South Carolina, U.S. Army Corps of Engineers, USACE, Department of the Army individual permit application, cooperating agency, least environmentally damaging practicable alternative, U.S. Environmental Protection Agency, Section 404(b) of the Clean Water Act, tribes	13. AVAILABILITY STATEMENT unlimited 14. SECURITY CLASSIFICATION *(This Page)* unclassified *(This Report)* unclassified 15. NUMBER OF PAGES 16. PRICE

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United States Nuclear Regulatory Commission

Protecting People and the Environment

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Abstract

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. Nuclear Regulatory Commission (NRC) by Duke Energy Carolinas, LLC (Duke) for two combined construction permits and operating licenses (combined licenses or COLs). The proposed actions requested in Duke's application are (1) NRC issuance of COLs for two nuclear power reactors at the William States Lee III Nuclear Station (Lee Nuclear Station) site in Cherokee County, South Carolina, and (2) U.S. Army Corps of Engineers (USACE) permit action on a Department of the Army individual permit application to perform certain construction activities on the site. The USACE is participating with the NRC in preparing this EIS as a cooperating agency and participates collaboratively on the review team.

This EIS includes the review team's analysis that considers and weighs the environmental impacts of building and operating two new nuclear units at the proposed Lee Nuclear Station site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts. The EIS also addresses Federally listed species, cultural resources, and plant cooling-system design alternatives.

The EIS includes the evaluation of the proposed project's impacts on waters of the United States pursuant to Section 404 of the Clean Water Act. The USACE will conduct a public interest review in accordance with the guidelines promulgated by the U.S. Environmental Protection Agency under authority of Section 404(b) of the Clean Water Act. The public interest review, which will be addressed in the USACE's permit decision document, will include an alternatives analysis to determine the least environmentally damaging practicable alternative.

After considering the environmental aspects of the proposed NRC action, the NRC staff's recommendation to the Commission is that the COLs be issued as requested.[a] This recommendation is based on (1) the application, including Revision 1 of the environmental report (ER) and the supplement to the ER, submitted by Duke; (2) consultation with Federal, State, Tribal, and local agencies; (3) the staff's independent review; (4) the staff's consideration of comments related to the environmental review that were received during the two public scoping processes and the draft EIS comment period; and (5) the assessments summarized in this EIS, including the potential mitigation measures identified in the ER and this EIS. The USACE will issue its Record of Decision based, in part, on this EIS.

(a) As directed by the Commission in CLI-12-16, the NRC will not issue the COLs prior to completion of the ongoing rulemaking to update the Waste Confidence Decision and Rule (see Section 6.1.6 of this EIS).

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Executive Summary

This environmental impact statement (EIS) presents the results of an U.S. Nuclear Regulatory Commission (NRC) environmental review of an application for combined construction permits and operating licenses (combined licenses or COLs) for two new nuclear reactor units at a proposed site in Cherokee County, South Carolina. The U.S. Army Corps of Engineers (USACE) participated in the preparation of the EIS as a cooperating agency and as a member of the review team, which consisted of the NRC staff, its contractor staff, and the USACE staff.

Background

On December 12, 2007, Duke Energy Carolinas, LLC (Duke), submitted an application to the NRC for COLs for William States Lee III Nuclear Station (Lee Nuclear Station) Units 1 and 2 in Cherokee County, South Carolina. The application was revised (Revision 1) by a letter dated March 30, 2009, and a supplement to the environmental report (ER) was submitted on September 24, 2009, describing Duke's plans to construct and operate an additional offsite reservoir (known as Make-Up Pond C) as a source of supplemental cooling water for the proposed station.

Upon docketing of Duke's initial application, the NRC review team began the environmental review process as described in 10 CFR Part 51 by publishing in the *Federal Register* on March 20, 2008, a Notice of Intent to prepare an EIS and conduct scoping. With the submittal of the September 2009 supplement to the ER, a second Notice of Intent to conduct a supplemental scoping process was published in the *Federal Register* on May 24, 2010. As part of the environmental review, the review team:

- considered comments received during the 60-day scoping process beginning March 20, 2008, and conducted related public scoping meetings on May 1, 2008 in Gaffney, South Carolina.
- considered comments received during a supplemental scoping period specific to Make-Up Pond C from May 24, 2010 through July 2, 2010, and conducted a related public scoping meeting on June 17, 2010, also in Gaffney, South Carolina.
- conducted site audits from April 28, 2008 through May 2, 2008 and from August 9, 2010 through August 13, 2010.
- conducted public meetings on the draft EIS on January 19, 2011 in Gaffney, South Carolina. The review team also considered comments received during the 75-day comment period for the draft EIS beginning on December 12, 2011.

- reviewed Duke's ER and Supplemental ER and developed requests for additional information (RAIs) using guidance from NUREG-1555, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants."
- consulted with American Indian Tribes and Federal and State agencies such as U.S. Fish and Wildlife Service, Advisory Council on Historic Preservation, National Marine Fisheries Service, Federal Energy Regulatory Commission, South Carolina Department of Natural Resources, South Carolina Department of Health and Environmental Control, and South Carolina Archives and History Center.

Proposed Action

The proposed actions related to the Lee Nuclear Station Units 1 and 2 application are (1) NRC issuance of COLs for construction and operation of two new nuclear plants at the Lee Nuclear Station site and (2) USACE issuance of a permit pursuant to Section 404 of the Federal Water Pollution Control Act (Clean Water Act) as amended to perform certain construction activities on the site.

Purpose and Need for Action

The purpose of the proposed action—issuance of the COLs—is to construct and operate two new nuclear units to provide for additional baseload electric generating capacity in 2024 and 2026 within Duke's service territories. The objective of Duke's requested USACE action is to obtain a Department of the Army individual permit to perform regulated dredge-and-fill activities that would affect wetlands and other waters of the United States.

Public Involvement

A 60-day scoping period was held from March 20, 2008 through May 20, 2008. A supplemental scoping period specific to Make-Up Pond C was held from May 24, 2010 through July 2, 2010. On June 17, 2010, the NRC held supplemental public scoping meetings in Gaffney, South Carolina. The review team received many oral comments during the public meetings and a total of 35 e-mails and 14 letters from both scoping periods on topics such as surface-water hydrology, ecology, socioeconomics, uranium fuel cycle, energy alternatives, and benefit-cost balance.

Additionally, on January 19, 2012, during the 75-day comment period on the draft EIS, the review team held public meetings in Gaffney, South Carolina. Approximately 250 people attended the public meetings and many provided oral comments.

Affected Environment

As proposed, the Lee Nuclear Station would be constructed in Cherokee County, South Carolina, on the same site as the former Duke Power Company Cherokee Nuclear Station. The site is 8 mi southeast of Gaffney, South Carolina and 25 mi northeast of Spartanburg, South Carolina. The area around the site is shown in Figure ES-1.

Cooling water for the units would be obtained from the Broad River. Makeup water from the Broad River would be provided to the plant via Make-Up Pond A. During periods of low flow when withdrawals from the Broad River are limited, makeup water would be provided from Make-Up Ponds B and C to Make-Up Pond A. Make-Up Ponds A and B already exist on the Lee Nuclear Station site. Make-Up Pond C would be built on the London Creek watershed to the northeast of the site. Construction of Make-Up Pond C would disturb approximately 1100 ac with permanent or temporary loss and alteration from flooding and clearing.

The Lee Nuclear Station would use mechanical draft cooling towers to transfer waste heat to the atmosphere. A portion of the water obtained from the Broad River would be returned to the environment via a discharge structure located in the Broad River on the upstream side of Ninety-Nine Islands Dam. The remaining portion of the water would be released to the atmosphere via evaporative cooling.

Evaluation of Environmental Impacts

When evaluating the environmental impacts associated with nuclear power plant construction and operations, the NRC's authority is limited to construction activities related to radiological health and safety or common defense and security; that is, NRC-authorized activities are related to safety-related structures, systems, or components, and may include pile driving; subsurface preparation; placement of backfill, concrete, or permanent retaining walls within an excavation; installation of foundations; or in-place assembly, erection, fabrication, or testing. In this EIS, the NRC review team evaluates the potential environmental impacts of the construction and operation of two new nuclear units for the following resource areas:

- land use
- air quality
- aquatic ecology
- terrestrial ecology
- surface and groundwater
- waste (radiological and nonradiological)
- human health (radiological and nonradiological)
- socioeconomics
- environmental justice
- cultural resources

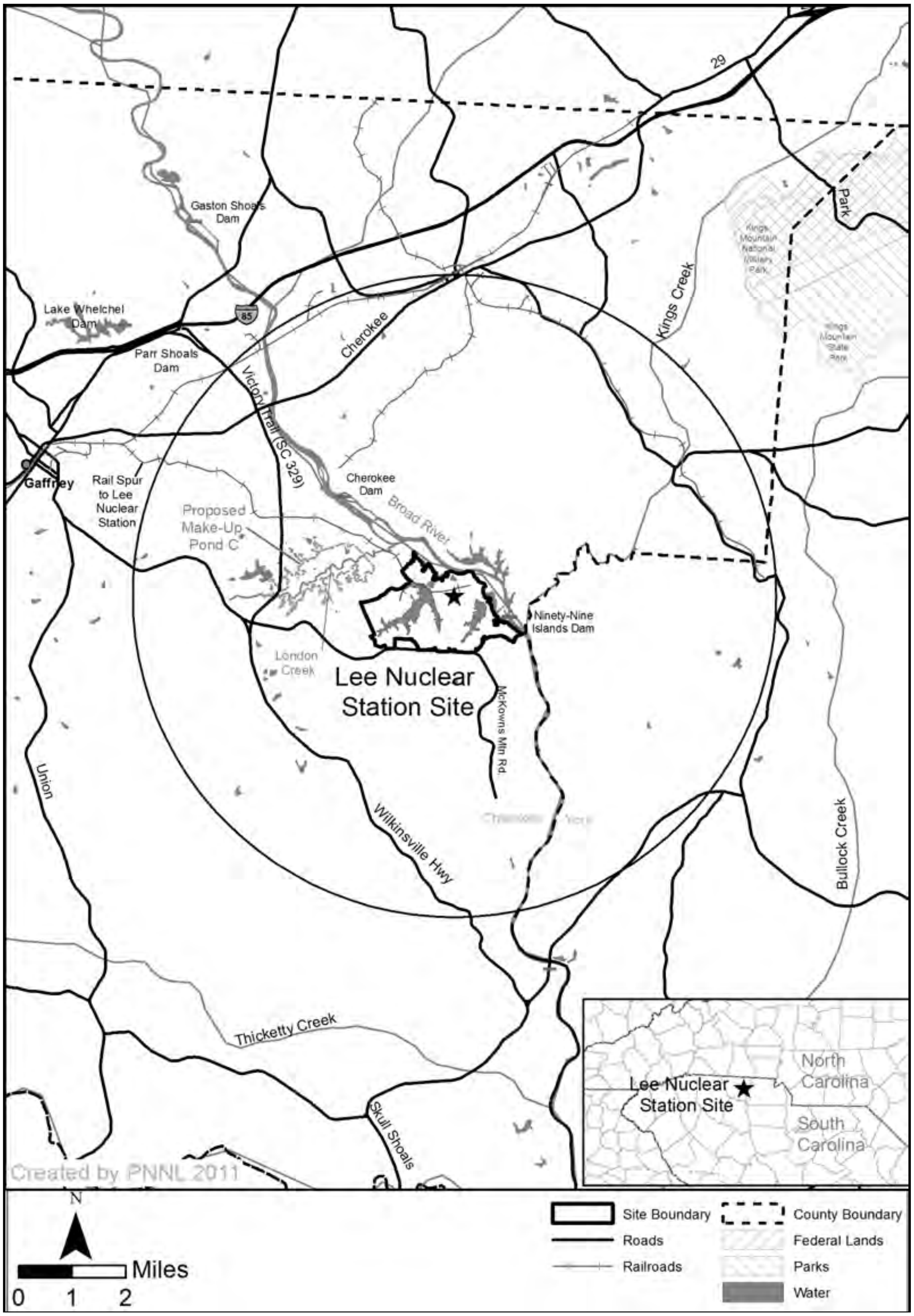

Figure ES-1. Lee Nuclear Station Site

It also evaluates impacts associated with accidents, the fuel cycle, decommissioning, and transportation of radioactive materials.

SMALL: Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE: Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE: Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impacts are designated as SMALL, MODERATE, or LARGE. The incremental impacts related to the construction and operations activities requiring NRC authorization are described and characterized, as are the cumulative impacts resulting from the proposed action when the effects are added to, or interact with, other past, present, and reasonably foreseeable future effects on the same resources.

The review team found that the cumulative environmental impacts on most aspects of water use and quality, most socioeconomic areas (adverse only), environmental justice, nonradiological and radiological health, severe accidents, fuel cycle, decommissioning, and transportation would be SMALL. The cumulative impacts for physical impacts and infrastructure and community services would be SMALL to MODERATE.

The review team found that the cumulative environmental impacts on land use, surface-water use, terrestrial and wetland ecosystems, aquatic ecosystems, air quality, and historic and cultural resources would be MODERATE. The impacts from NRC-authorized activities would be SMALL for all of the above-listed resource areas. The incremental impacts associated with the development of transmission lines and Make-Up Pond C would be the principal contributors to the MODERATE cumulative land-use impacts. Potential future water-supply issues in the Broad River Basin would be the primary driver for the MODERATE impact for surface-water use. Cumulative terrestrial and wetland ecosystem impacts would be MODERATE because of the loss of habitat from development of transmission-line corridors. The development of Make-Up Pond C would have cumulative aquatic ecosystem impacts on London Creek and its tributaries. The MODERATE cumulative impact on air quality would result from the existing concentration of greenhouse gases in the atmosphere. The review team found cumulative impacts from Make-Up Pond C development and transmission-line corridor development would contribute to the MODERATE impact for historic and cultural resources.

The review team found no LARGE, adverse cumulative impacts.

Table ES-1 provides a summary of the cumulative impacts for the proposed site.

Table ES-1. Cumulative Impacts on Environmental Resources, Including the Impacts of Proposed Lee Nuclear Station

Resource Category	Impact Level
Land use	MODERATE
Water-related	
Surface-water use	MODERATE
Groundwater use	SMALL
Surface-water quality	SMALL
Groundwater quality	SMALL
Ecology	
Terrestrial ecosystems	MODERATE
Aquatic ecosystems	MODERATE
Socioeconomic	
Physical impacts	SMALL to MODERATE
Demography	SMALL
Economic impacts on the community	SMALL to LARGE (beneficial)
Infrastructure and community services	SMALL to MODERATE
Aesthetics and recreation	SMALL
Environmental justice	SMALL
Historic and cultural resources	MODERATE
Air quality	MODERATE
Nonradiological health	SMALL
Radiological health	SMALL
Severe accidents	SMALL
Fuel cycle, transportation, and decommissioning	SMALL

Alternatives

The review team considered the environmental impacts associated with alternatives to issuing COLs for Lee Nuclear Station. These alternatives included a no-action alternative (i.e., not issuing the COLs), and alternative energy sources, siting locations, or system designs.

The **no-action alternative** would result in the COLs not being granted or the USACE not issuing its permit. Upon such a denial, construction and operation of the two units at the Lee Nuclear Station site would not occur and the predicted environmental impacts would not take place. If no other facility would be built or strategy implemented to take its place, the benefits of the additional electrical capacity and electricity generation to be provided would also not occur and the need for baseload power would not be met.

Based on the review team's review of **energy alternatives**, the review team concluded that, from an environmental perspective, none of the viable alternatives is clearly environmentally preferable to building a new baseload nuclear power generation plant at the Lee Nuclear Station site. The review team eliminated several energy sources (i.e., wind, solar, and biomass) from full consideration because they are not currently capable of meeting the need of this project. None of the viable baseload alternatives (natural gas, coal, or a combination of alternatives) was environmentally preferable to the proposed nuclear units.

After comparing the cumulative effects of the proposed site against those of the **alternative sites**, the review team concluded that none of the alternative sites would be environmentally preferable to the proposed site for building and operating a new nuclear power plant. The three alternatives sites selected were the following:

- Perkins site (previously considered for the Perkins Nuclear Station), Davie County, North Carolina (Figure ES-2),
- Keowee site (adjacent to Oconee Nuclear Station), Oconee County, South Carolina (Figure ES-3),
- Middleton Shoals site, Anderson County, South Carolina (Figure ES-4).

Table ES-2 provides a summary of the cumulative impacts for the alternative sites. The review team concluded that all of the sites were generally comparable, and it would be difficult to state that one site is preferable to another from an environmental perspective. In such a case, the proposed site prevails because none of the alternatives is clearly environmentally preferable.

The review team considered various **alternative systems designs**, including seven alternative heat-dissipation systems and multiple alternative intake, discharge, and water-supply systems. The review team identified no alternatives that were environmentally preferable to the proposed Lee Nuclear Station plant systems design.

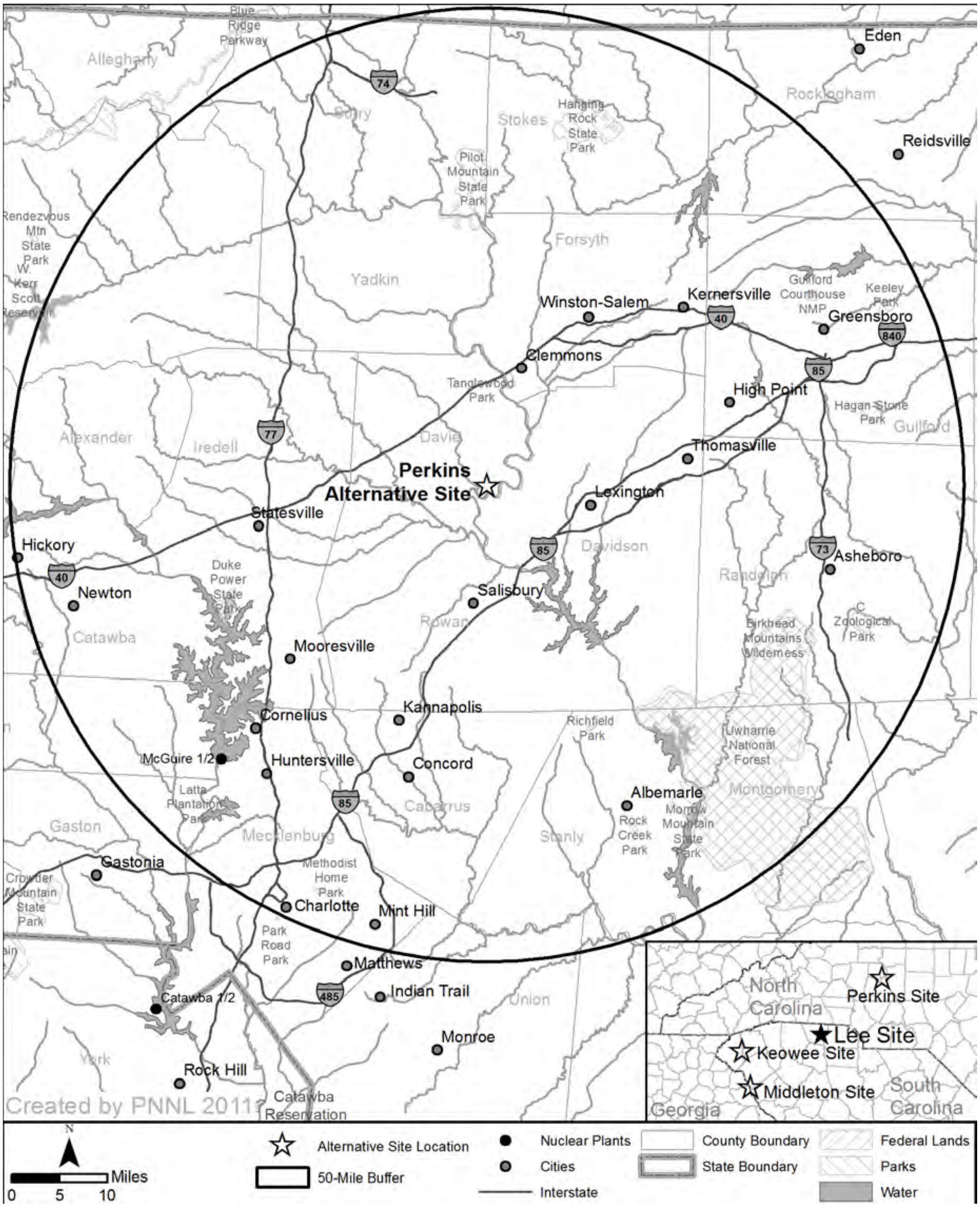

Figure ES-2. Perkins Site

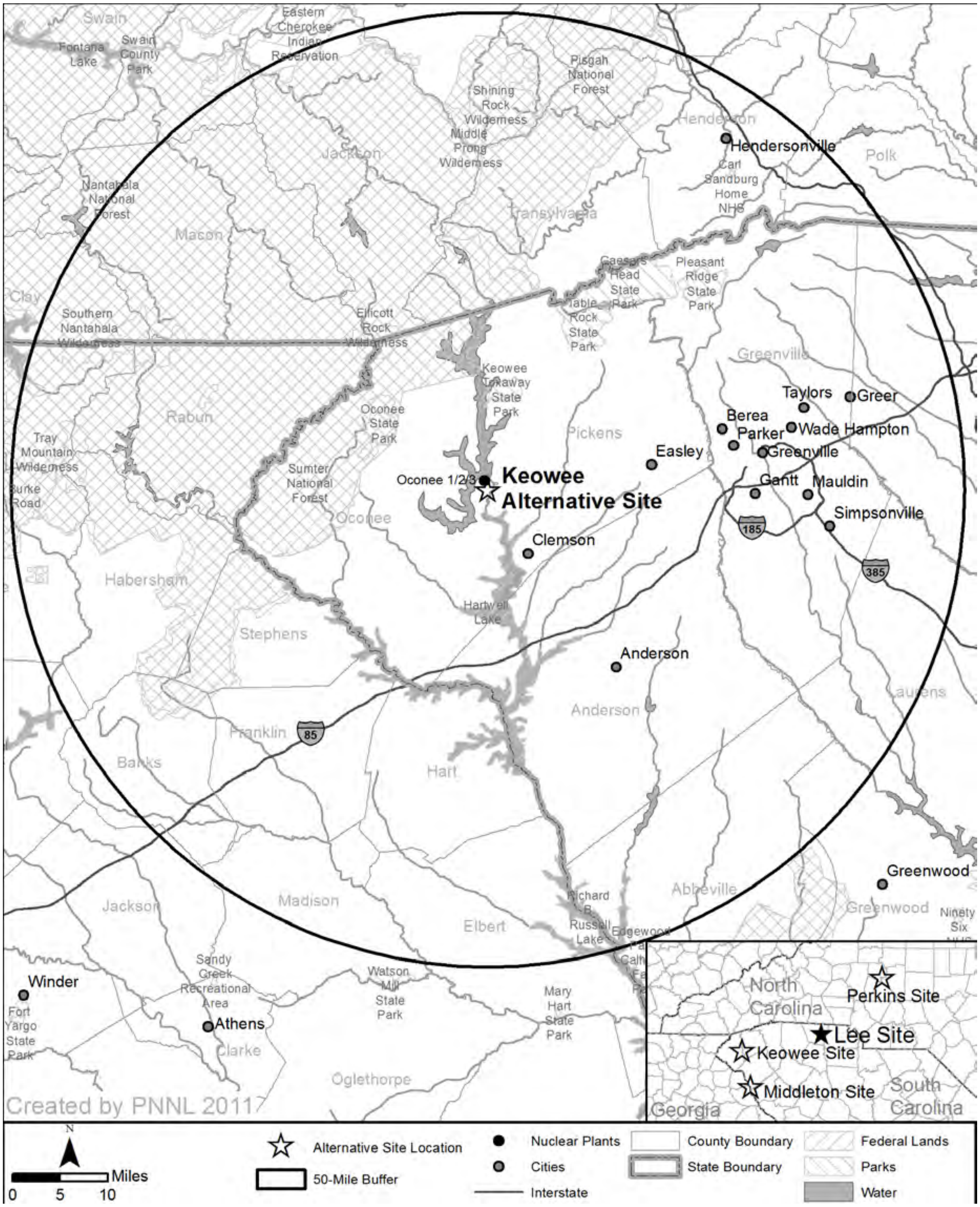

Figure ES-3. Keowee Site

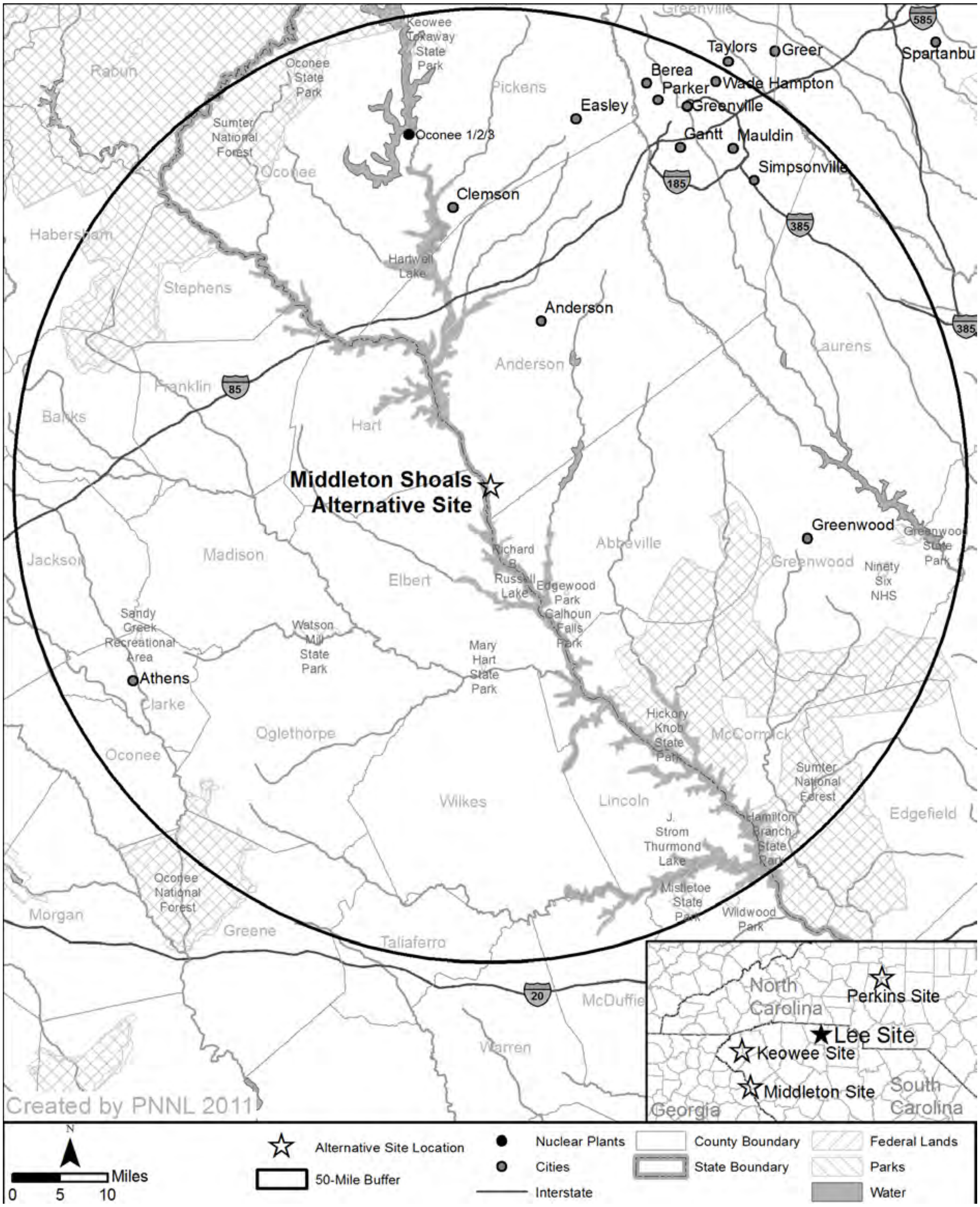

Figure ES-4. Middleton Shoals Site

Benefits and Costs

The review team compiled and compared the pertinent analytical conclusions reached in the EIS. It gathered all of the expected impacts from building and operating the proposed Lee Nuclear Station and aggregated them into two final categories: (1) the expected environmental costs and (2) the expected benefits to be derived from approval of the proposed action. Although the analysis in Section 10.6 is conceptually similar to a purely economic benefit-cost analysis, which determines the net present dollar value of a given project, the intent of the section is to identify potential societal benefits of the proposed activities and compare them to the potential internal (i.e., private) and external (i.e., societal) costs of the proposed activities. In general, the purpose is to inform the COL process by gathering and reviewing information that demonstrates the likelihood that the benefits of the proposed activities outweigh the aggregate costs.

On the basis of the assessments in this EIS, the building and operation of the proposed Lee Nuclear Station, with mitigation measures identified by the review team, would accrue benefits that most likely would outweigh the economic, environmental, and social costs. For the NRC-proposed action (i.e., NRC-authorized construction and operation), the accrued benefits would also outweigh the costs of preconstruction, construction, and operation of the proposed Lee Nuclear Station.

Recommendation

The NRC's recommendation to the Commission related to the environmental aspects of the proposed action is that the COLs should be issued as proposed.

This recommendation is based on the following:

- the application, including the ER and its revisions, submitted by Duke
- consultation with Federal, State, Tribal, and local agencies
- consideration of public comments received during scoping and on the draft EIS
- the review team's independent review and assessment detailed in this EIS.

In making its recommendation, the review team determined that none of the alternative sites is environmentally preferable (and, therefore, also not obviously superior) to the Lee Nuclear Station site. The review team also determined that none of the energy or cooling-system alternatives assessed is environmentally preferable to the proposed action.

The NRC's determination is independent of the USACE's determination of whether the Lee Nuclear Station site is the least environmentally damaging practicable alternative pursuant to Clean Water Act Section 404(b) (1) Guidelines. The USACE will conclude its analysis of both offsite and onsite alternatives in its Record of Decision.

Table ES-2 provides a summary of the EIS-derived cumulative impacts for the proposed site in comparison with the no-action alternative, alternative sites, and energy alternatives.

Table ES-2. Comparison of Environmental Impacts

Resource Areas	Proposed Site[(a)]	Alternative Sites[(b)]			Energy Alternatives[(c)]		
	Lee	**Perkins**	**Keowee**	**Middleton Shoals**	**Coal**	**Natural Gas**	**Combination**
Land Use	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Surface Water	MODERATE	MODERATE	MODERATE	MODERATE	SMALL	SMALL	SMALL
Groundwater	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Aquatic Ecosystems	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Terrestrial Ecosystems	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Air Quality	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	MODERATE	SMALL to MODERATE	SMALL to MODERATE
Socioeconomics	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to LARGE (beneficial)	MODERATE (adverse) to MODERATE (beneficial)	MODERATE (adverse) to MODERATE (beneficial)
Environmental Justice	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Cultural Resources	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Human Health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Waste Management	SMALL	SMALL	SMALL	SMALL	MODERATE	SMALL	SMALL

(a) Cumulative impact determinations taken from Table 7-4 in the EIS.
(b) Cumulative impact determinations taken from Table 9-18 in the EIS.
(c) Impacts taken from Table 9-4 in the EIS. These conclusions for energy alternatives should be compared to NRC-authorized activities reflected in Chapters 4, 5, 6.1, and 6.2.

Abbreviations/Acronyms

7Q10	lowest flow for 7 consecutive days expected to occur once per decade
AADT	annual average daily traffic
ac	acre(s)
ac-ft	acre feet
ACS	American Community Survey
AD	Anno Domini
ADAMS	Agencywide Documents Access and Management System
ALARA	as low as reasonably achievable
AP1000	Advanced Passive 1000 pressurized water reactor
APE	Area of Potential Effect
AQCR	Air Quality Control Region
ARRA	American Recovery and Reinvestment Act of 2009
BACT	Best Available Control Technologies
BC	before Christ
BEA	Bureau of Economic Analysis
BEIR	Biological Effects of Ionizing Radiation
BGEPA	Bald and Golden Eagle Protection Act
BLS	Bureau of Labor Statistics
BMP	best management practice
BOD	biochemical oxygen demand
Bq	becquerel(s)
Btu	British thermal unit(s)
°C	degree(s) Celsius
CAES	compressed air-energy storage
CAIR	Clean Air Interstate Rule
CDC	U.S. Centers for Disease Control and Prevention
CDF	core damage frequency
CESQG	conditionally exempt small quantity generator
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic foot/feet per second
Ci	curie(s)
cm	centimeter(s)
CMC	criterion maximum concentration
CO	carbon monoxide
CO_2	carbon dioxide

COL	combined construction permit and operating license
CORMIX	Cornell Mixing Zone Expert System
CPCN	Certificate of Environmental Compatibility and Public Convenience and Necessity
CSAPR	Cross-State Air Pollution Rule
CWA	Clean Water Act (aka Federal Water Pollution Control Act)
CWS	circulating-water system
d	day(s)
DA	Department of the Army
dB	decibel(s)
dBA	decibel(s) on the A-weighted scale
DBA	design basis accident
DBH	diameter breast high
DCD	Design Control Document
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
D/Q	deposition factor(s); annual normalized total surface concentration rate(s)
DSM	demand-side management
DTA	Devine Tarbell & Associates
Duke	Duke Energy Carolinas, LLC
Duke Energy	Duke Energy Corporation
EAB	exclusion area boundary
EE	energy efficiency
EECBG	Energy Efficiency and Conservation Block Grant
EIA	Energy Information Administration
EIS	environmental impact statement
ELF	extremely low frequency
EMF	electromagnetic field
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
EPT	Ephemeroptera-Plecoptera-Trichoptera (Index)
ER	environmental report
ESP	Early Site Permit
ESRP	Environmental Standard Review Plan
°F	degree(s) Fahrenheit
FAA	Federal Aviation Administration
FES	Final Environmental Statement
FEIS	Final Environmental Impact Statement

FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FP&S	Facilities Planning & Siting
fps	foot (feet) per second
FR	*Federal Register*
FSAR	Final Safety Analysis Report
FSER	Final Safety Evaluation Report
ft	foot/feet
ft^2	square foot/feet
ft^3	cubic foot/feet
FWS	U.S. Fish and Wildlife Service
µg	microgram(s)
g	gram(s)
gal	gallon(s)
GC	gas centrifuge
GCRP	U.S. Global Change Research Program
GD	gaseous diffusion
GDNR	Georgia Department of Natural Resources
GEIS	Generic Environmental Impact Statement
GHG	greenhouse gas
GIS	geographic information system
gpd	gallon(s) per day
gpm	gallon(s) per minute
GWh	gigawatt-hours
HAP	hazardous air pollutant
HDPE	high-density polyethylene
HLW	high-level waste
hr	hour(s)
Hz	hertz
HZI	hydraulic zone of influence
I	U.S. Interstate
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IGCC	integrated gasification combined cycle
in.	inch(es)
INEEL	Idaho National Engineering and Environmental Laboratory
IRP	Integrated Resource Plan
IRWST	in-containment refueling water storage tank

Abbreviations/Acronyms

ISFSI	independent spent fuel storage installation
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
km/hr	kilometer(s) per hour
kV	kilovolt(s)
kW	kilowatt(s)
kW(e)	kilowatt(s) electric
kWh	kilowatt-hour(s)
L	liter(s)
LEDPA	least environmentally damaging practicable alternative
LFG	landfill-based gas
LLC	Limited Liability Company
LLW	low-level waste
LOS	level of service
LPZ	low-population zone
LWA	Limited Work Authorization
LWR	light water reactor
m	meter(s)
m^2	square meter(s)
m^3	cubic meter(s)
m^3/s	cubic meter(s) per second
MACCS2	Melcor Accident Consequence Code System Version 1.12
mg	milligram(s)
MEI	maximally exposed individual
Mgd	million gallon(s) per day
mGy	milligray(s)
mi	mile(s)
mi^2	square mile(s)
mL	milliliter(s)
mm	millimeter(s)
MMS	U.S. Department of Interior Minerals Management Service
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MOX	mixed oxides
mpg	mile(s) per gallon
mph	mile(s) per hour
mrad	millirad

mrem	millirem
MSDS	material safety data sheets
MSL	mean sea level
mSv	millisievert(s)
MSW	municipal solid waste
MT	metric ton(nes)
MTU	metric ton(nes) uranium
MW	megawatt(s)
MW(e)	megawatt(s) electric
MWh	megawatt-hour(s)
MW(t)	megawatt(s) thermal
MWd	megawatt-day(s)
MWd/MTU	megawatt-days per metric ton of uranium
NA	not applicable
NAAQS	National Ambient Air Quality Standard
NAGPRA	Native American Graves Protection and Repatriation Act
NC	North Carolina
NCDENR	North Carolina Department of Environment and Natural Resources
NCI	National Cancer Institute
NCRP	National Council on Radiation Protection and Measurements
NCUC	North Carolina Utility Commission
NCWRC	North Carolina Wildlife Resources Commission
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act of 1969, as amended
NERC	North American Electric Reliability Corporation
NESC	National Electrical Safety Code
NGCC	natural gas combined cycle
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NIEHS	National Institute of Environmental Health Sciences
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NSPS	new source performance standard
NSR	new source review

NUREG	U.S. Nuclear Regulatory Commission technical document
NVC	National Vegetation Classification
NWI	National Wetlands Inventory
NWS	National Weather Service
OCS	outer continental shelf
ODCM	Offsite Dose Calculation Manual
OECD	Organization for Economic Cooperation and Development
OSHA	Occupational Safety and Health Administration
pH	measure of acidity or basicity in solution
PIRF	public interest review factor
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter 2.5 microns or less
PNNL	Pacific Northwest National Laboratory
pp.	pages
ppb	part(s) per billion
ppm	part(s) per million
PRA	probabilistic risk assessment
PSCSC	Public Service Commission of South Carolina
PSD	Prevention of Significant Deterioration (Permit)
PUC	public utility commission
PURC	Public Utility Review Committee
PURPA	Public Utility Regulatory Policies Act of 1978
PV	photovoltaic
PWR	pressurized water reactor
PWS	potable water service
rad	radiation absorbed dose
RAI	Request(s) for Additional Information
RCRA	Resource Conservation and Recovery Act of 1976, as amended
REC	renewable energy credit(s)
rem	roentgen equivalent man
REMP	radiological environmental monitoring program
REPS	renewable energy portfolio standard(s)
RFP	request for proposal
RIMS II	Regional Input-Output Modeling System
RM	river mile
ROI	region of interest

ROW	right-of-way
RRS	(SERC's) Reliability Review Subcommittee
RWS	raw water service
Ryr	reactor year
μS/cm	microsievert(s) per centimeter
s or sec	second(s)
SACTI	Seasonal/Annual Cooling Tower Impact (prediction code)
SAMA	severe accident mitigation alternative
SAMDA	severe accident mitigation design alternative
SC	South Carolina
SCBCB	South Carolina Budget and Control Board
SCDAH	South Carolina Department of Archives and History
SCDHEC	South Carolina Department of Health and Environmental Control
SCDNR	South Carolina Department of Natural Resources
SCDOT	South Carolina Department of Transportation
SCDSS	South Carolina Department of Social Services
SCE&G	South Carolina Electric and Gas
SCIAA	South Carolina Institute of Archaeology and Anthropology
SCR	selective catalytic reduction
SDS	sanitary drainage system
SER	Safety Evaluation Report
SERC	Southeastern Electric Reliability Council
SHA	seismic hazard analysis
SHPO	State Historic Preservation Office (or Officer)
SMCL	secondary maximum concentration limits
SO_2	sulfur dioxide
SO_x	oxides of sulfur
SPCCP	Spill prevention, control, and countermeasure plan
SRS	Savannah River Site
Sv	sievert(s)
SWPPP	stormwater pollution prevention plan
SWS	service-water system
T	ton(s)
T&E	threatened and endangered
TDS	total dissolved solids
TEDE	total effective dose equivalent
THPO	Tribal Historic Preservation Officer
TRAGIS	Transportation Routing Analysis Geographic Information System

Abbreviations/Acronyms

TSC	technical support center
UF_6	uranium hexafluoride
UMTRI	University of Michigan Transportation Research Institute
UO_2	uranium dioxide
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
US	U.S. (State Highway)
VACAR	Virginia-Carolinas (subregion)
VCSNS	Virgil C. Summer Nuclear Station
VEGP	Vogtle Electric Generating Plant
VOC	volatile organic compound
WCD	waste confidence decision
Westinghouse	Westinghouse Electric Company, LLC
WWS	wastewater service
χ/Q	atmospheric dispersion factor(s); annual average normalized air concentration value(s)
yd	yard(s)
yd^3	cubic yard(s)
yr	year(s)
yr^{-1}	per year

Appendix E

Draft Environmental Impact Statement Comments and Responses

Appendix E

Draft Environmental Impact Statement Comments and Responses

As part of the U.S. Nuclear Regulatory Commission (NRC) review of the William States Lee III Nuclear Station (Lee Nuclear Station) application for combined construction permits and operating licenses (COLs) for proposed Units 1 and 2 at the Lee Nuclear Station site, located in Cherokee County, South Carolina, the NRC and the U.S. Army Corps of Engineers (USACE) (together referred to as the "review team") solicited comments from the public on the draft environmental impact statement (EIS). The draft EIS was issued on December 13, 2011. A 75-day comment period began on December 23, 2011, when the U.S. Environmental Protection Agency (EPA) issued a *Federal Register* Notice of Availability (76 FR 80367) of the draft EIS to allow members of the public to comment on the results of the environmental review.

As part of the process to solicit public comments on the draft EIS, the review team

- placed a copy of the draft EIS at the Cherokee County Public Library in Gaffney, South Carolina
- made the draft EIS available in the NRC's Public Document Room in Rockville, Maryland, (NRC 2011a)
- placed a copy of the draft EIS on the NRC website at www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2111/
- provided a copy of the draft EIS to the Lee Nuclear Station environmental review mailing list and any member of the public who requested one
- sent copies of the draft EIS to certain Federal, State, Tribal, and local agencies
- published a notice of availability of the draft EIS in the *Federal Register* on December 21, 2011 (76 FR 79228)
- filed the draft EIS with the EPA
- held two public meetings on Thursday, January 19, 2012 in Gaffney, South Carolina.

Approximately 250 people attended the public meetings in Gaffney and numerous participants provided oral comments. A certified court reporter recorded these oral comments and prepared written transcripts of the meeting. The transcripts (NRC 2012a) of the public meetings were published on February 13, 2012 as part of the public meeting summary (NRC 2012b). In addition to the comments received at the public meeting, the NRC received letters and e-mail messages with comments concerning the proposed Lee Nuclear Station.

The comment letters, e-mail messages, and transcripts of the public meeting are available in the NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible at http://www.nrc.gov/reading-rm.html. Persons who do not have access to ADAMS or who encounter problems in accessing the documents located in ADAMS should contact the NRC's Public Document Room reference staff at 1-800-397-4209 or 301-415-4737. The ADAMS accession numbers for the letters, e-mail messages, and transcripts are provided in Table E-1.

E.1 Disposition of Comments

Each set of comments from a given commenter was given a unique correspondence identifier, allowing each set of comments from a commenter to be traced back to the transcript, letter, or e-mail in which the comments were submitted. After the comment period concluded, the review team considered and dispositioned all comments received. To identify each individual comment, the team reviewed the transcripts of the public meetings and each piece of correspondence received related to the draft EIS. As part of the review, the review team identified statements that it believed were related to the proposed action and recorded the statements as comments. Each comment was assigned to a specific subject area, and similar comments were grouped together. Finally, responses were prepared for each comment or group of comments.

Some comments addressed topics and issues that are not part of the environmental review for this proposed action. These comments included questions about NRC's safety review, general statements of support or opposition to nuclear power, and comments on the NRC regulatory process in general. These comments are included, but detailed responses are not provided because the comments address issues not directly related to the environmental effects of this proposed action and are, thus, outside the scope of the National Environmental Policy Act of 1969, as amended (NEPA) review of this proposed action. If appropriate, these comments were forwarded to the appropriate organization within the NRC for consideration. Many comments, however, specifically addressed the scope of the environmental review, analyses, and issues contained in the draft EIS. Examples include comments about potential impacts, proposed mitigation, the agency review process, and the public comment period. Detailed responses to each of these comments are provided in this appendix. When the comments resulted in a change in the text of the draft EIS, the corresponding response refers the reader to the appropriate section of the EIS where the change was made. Throughout the final EIS, with the exception of this new Appendix E, revisions (other than editorial) to the text from the draft EIS are indicated by vertical lines (change bars) in the margin beside the text.

Table E-1 provides a list of commenters identified by name, affiliation (if given), comment number, and the source of the comment.

Table E-1. Individuals Providing Comments During the Comment Period

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
Anonymous		Letter (ML12068A408)	0137
Anonymous		Letter (ML12072A084)	0112
Anonymous		Email (ML12037A005)	0076
Acs, Deborah		Letter (ML12048A668)	0107
Adams, Rod		Meeting Transcript (ML120260611)	0012-12
Adams, Rod		Meeting Transcript (ML120260614)	0013-12
Allison, Patricia		Letter (ML12033A158)	0085
Andrews, Josephine		Letter (ML12060A278)	0112
Apunte, Daya	INviro Design and Consulting, LLC	Email (ML12068A011)	0131
Arnold, Debbie		Email (ML12025A130)	0003
Atanasoff, Mike		Email (ML12038A023)	0078
Baker, Kasey		Meeting Transcript (ML120260614)	0013-6
Beach, William		Meeting Transcript (ML120260614)	0013-34
Beattie, Kathryn E.		Letter (ML12060A280)	0112
Bertram, Beth		Email (ML12025A217)	0044
Bisesi, Philip		Letter (ML12039A144)	0103
Bisesi, Philip		Meeting Transcript (ML120260614)	0013-31
Bliss, Rachel		Letter (ML12039A145)	0104
Bliss, Rachel		Meeting Transcript (ML120260614)	0013-13
Boever, Virginia		Letter (ML12151A384)	0112
Boger, Paul	Greater York Chamber of Commerce	Meeting Transcript (ML120260611)	0012-14
Boots, Debby		Email (ML12025A231)	0052
Boyle, Ella		Letter (ML12060A279)	0112
Brackett, Cheri		Email (ML12025A175)	0023
Broadhead, Susan		Letter (ML12033A156)	0083
Broadhead, Susan		Letter (ML12039A139)	0098
Broadhead, Susan		Meeting Transcript (ML120260614)	0013-33

Table E-1. (contd)

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
Brockington, Mary Sue and William B.		Letter (ML12083A063)	0144
Brogan Prindle, Cathleen		Letter (ML12048A664)	0112
Bromm, Bob		Meeting Transcript (ML120260614)	0013-18
Burnett, Linda		Letter (ML12058A4001)	0115
Burt, Rick		Email (ML12025A204)	0038
Buscarino, John	Active Students for a Healthy Environment	Meeting Transcript (ML120260614)	0013-23
Cahill, Joanne		Email (ML12068A012)	0132
Caldwell, Mark	U.S. Fish and Wildlife Service	Letter (ML120760114)	0141
Christopher, Lucy D.		Letter (ML1206A2331)	0133
Clere, Daniel		Email (ML12067A014)	0125
Collins, Richard		Email (ML12025A203)	0037
Conard, Sky	Green River Watershed Alliance	Email (ML12067A018)	0127
Conard, Sky	Green River Watershed Alliance	Letter (ML12039A135)	0094
Conard, Sky	Green River Watershed Alliance	Meeting Transcript (ML120260611)	0012-4
Connolly, Mary Ellen		Meeting Transcript (ML120260611)	0012-10
Cook, Jim	Cherokee County Development Board	Meeting Transcript (ML120260611)	0012-17
Cox, Judith		Email (ML12025A138)	0010
Craig, Anne		Letter (ML12039A136)	0095
Craig, Anne		Letter (ML12039A136)	0105
Craig, Anne		Meeting Transcript (ML120260614)	0013-20
Craig, Tom		Email (ML12032A004)	0060
Cranford, Kelley		Meeting Transcript (ML120260614)	0013-36
Cremer, Claudine		Meeting Transcript (ML120260614)	0013-5
Crissey, Brian		Email (ML12067A002)	0117
Crissey, Brian		Meeting Transcript (ML120260611)	0012-8
Cunningham, Kristine		Email (ML12025A131)	0004
da Silva, Arjuna		Email (ML12032A008)	0063

Table E-1. (contd)

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
Dailey, Debbie		Letter (ML12072A078)	0139
Dailey, Debbie		Meeting Transcript (ML120260614)	0013-19
Davis, John		Letter (ML12058A396)	0112
DeLap, E.A.		Email (ML12030A006)	0057
Dixon, Mary		Email (ML12025A178)	0025
Dobrasko, Rebekah	South Carolina Dept. of Archives and History	Letter (ML12048A671)	0109
Doebber, Ian		Email (ML12025A179)	0026
Doebber, Rachel		Email (ML12025A181)	0026
Doebber, Rachel		Email (ML12025A181)	0028
Doebber, Tom		Email (ML12025A148)	0019
Drouin, Michaeljon		Letter (ML12033A160)	0087
Fallon, Chris	Duke Energy	Letter (ML12067A037)	0134
Fallon, Chris	Duke Energy	Meeting Transcript (ML120260614)	0013-4
Farris, Mark	Economic Development Board of York County	Meeting Transcript (ML120260611)	0012-16
Fisk, Bill		Letter (ML12048A670)	0108
Fisk, Bill		Meeting Transcript (ML120260614)	0013-27
Flaherty, David		Email (ML12025A133)	0006
Flores, S.		Letter (ML12062A070)	0112
G., Edith A.		Letter (ML12072A079)	0140
Gaddy, Ron		Email (ML12026A401)	0054
Gamble, Dan	INviro Design and Consulting, LLC	Email (ML12067A022)	0129
Gamble, Dan	INviro Design and Consulting, LLC	Letter (ML12039A142)	0101
Gamble, Dan	INviro Design and Consulting, LLC	Letter (ML12068A407)	0136
Gamble, Dan	INviro Design and Consulting, LLC	Meeting Transcript (ML120260614)	0013-10
Gardner, David		Email (ML12025A201)	0035
Gardner, Janet		Email (ML12025A198)	0033
Gardner, Janet	Weluvgems	Email (ML12025A200)	0034
Genetti, Phyllis		Letter (ML12048A669)	0110
Gilbert, Grace		Email (ML12037A006)	0077
Gilman, Steve	Physicians for Social Responsibility	Meeting Transcript (ML120260611)	0012-6
Glaser, Christine		Email (ML12025A187)	0031

Table E-1. (contd)

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
Gossett, Lewis	South Carolina Manufacturers Alliance	Meeting Transcript (ML120260611)	0012-9
Greenberg, Lori		Letter (ML12039A140)	0099
Greenburg, Lori		Meeting Transcript (ML120260614)	0013-29
Gregg, Ben	South Carolina Wildlife Federation	Letter (ML12068A364)	0135
Guy, Peggy		Meeting Transcript (ML120260614)	0013-15
Hamahan, Clare		Letter (ML12146A266)	0112
Hammett, Jan		Meeting Transcript (ML120260614)	0013-35
Hayes, MD, J. David		Email (ML12067A013)	0124
Hearne, Ray		Letter (ML12048A666)	0106
Hearne, Ray		Meeting Transcript (ML120260614)	0013-24
Hicks, Katie	Clean Water for North Carolina	Letter (ML12039A131)	0090
Hicks, Katie	Clean Water for North Carolina	Meeting Transcript (ML120260611)	0012-7
Holt, Cathy		Email (ML12032A005)	0061
Holt, Cathy		Meeting Transcript (ML120260614)	0013-32
Howarth, Irma		Letter (ML12039A133)	0092
Howarth, Irma		Meeting Transcript (ML120260611)	0012-19
Howarth, Robert F.	Western N. Carolina Physicians for Social Responsibility	Letter (ML12039A134)	0093
Howarth, Robert F.	Western N. Carolina Physicians for Social Responsibility	Meeting Transcript (ML120260611)	0012-13
Howell, Martha N.	Blue Ridge Community College	Email (ML12025A145)	0016
Jamil, Dhiaa	Duke Energy	Meeting Transcript (ML120260611)	0012-2
Justice, Cynthia and Michael		Email (ML12067A011)	0122
Karpen, Leah R.		Letter (ML12023A052)	0082
Keil, A. Eugene		Letter (ML12151A382)	0112
Kelly, Kitty		Email (ML12025A136)	0008
Klein, Art and Michelle		Email (ML12025A150)	0020
Knudten, Cori		Letter (ML12052A209)	0111

Table E-1. (contd)

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
Larsen Clark, Brita		Meeting Transcript (ML120260611)	0012-15
Larson, Jean		Letter (ML12039A138)	0097
Larson, Jean		Meeting Transcript (ML120260614)	0013-22
Lauden, Loy		Email (ML12025A222)	0047
Lemoing, Melissa		Letter (ML12033A157)	0084
Leverette, Will		Letter (ML12072A083)	0112
Lewis, Brenda K.		Email (ML12025A132)	0005
Lovinsohn, Ruth		FAX (ML12044A128)	0088
Lovinsohn, Ruth		Letter (ML12058A397)	0114
Macko, Karl		Letter (ML12151A383)	0145
Mayfield, Julie	Western North Carolina Alliance and Green River Watershed Alliance	Email (ML12067A020)	0128
McAfee, Patricia B.		Letter (ML12083A061)	0143
McFadden, Cindy	Cherokee2020	Letter (ML12039A132)	0091
McMahon, John		Email (ML12025A207)	0041
McWherter, Lisa		Meeting Transcript (ML120260614)	0013-30
Mewborne, Janice		Email (ML12025A218)	0045
Miller, John C.		Email (ML12025A142)	0011
Morgan, Tom and Barbara		Email (ML12025A146)	0017
Moss, Representative Dennis	South Carolina House of Representatives, District 29	Letter (ML12039A137)	0096
Moss, Representative Dennis	South Carolina House of Representatives, District 29	Meeting Transcript (ML120260614)	0013-1
Moss, Representative Steve	South Carolina House of Representatives, District 30	Meeting Transcript (ML120260614)	0013-2
Mueller, Heinz	U.S. Environmental Protection Agency, Region 4	Letter (ML120790121)	0142
Nord, Felice		Email (ML12025A180)	0027
Norris, Steve		Meeting Transcript (ML120260614)	0013-21
Oehler, Susan		Email (ML12025A229)	0051
Paterson, Wallace		Email (ML12025A208)	0042

Table E-1. (contd)

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
Patrie, MD, MPH, Lewis E.	Western North Carolina Physicians for Social Responsibility	Email (ML12030A145)	0058
Peterson, Harry		Letter (ML12072A081)	0112
Peterson, Martha J.		Letter (ML12072A082)	0112
Raleigh, Carolyn		Email (ML12030A146)	0059
Rawl, Otis	South Carolina Chamber of Commerce	Meeting Transcript (ML120260611)	0012-5
Reeser, Rachel		Email (ML12025A216)	0043
Reichenbach, Adam		Meeting Transcript (ML120260614)	0013-17
Rhyne, Faith Rachel		Email (ML12030A005)	0056
Richards, Kitty Katherine		Meeting Transcript (ML120260614)	0013-28
Richardson, Don		Letter (ML12039A141)	0100
Richardson, Don		Meeting Transcript (ML120260614)	0013-14
Richardson, Ed		Email (ML12025A202)	0036
Rinsler, MD, Steve		Email (ML12025A151)	0021
Rittenberg, David		Letter (ML12048A662)	0112
Rose, Katherine		Email (ML12046A154)	0113
Rustin, K.		Letter (ML12072A080)	0112
Ruthye100, You Tube Service		Email (ML12025A224)	0049
Ruthye100, You Tube with Text		Email (ML12025A228)	0050
Rylander, Kimchi	Earthaven Ecovillage	Letter (ML12033A159)	0086
Sadler, Timothy		Meeting Transcript (ML120260614)	0013-25
Schmid, Erich K.		Email (ML12026A398)	0053
Schmitt, Brynn		Email (ML12046A151)	0079
Schmitt, Brynn		Letter (ML12072A077)	0138
Schmitt, Daniel		Letter (ML12067A095)	0116
Schneyer, Julie		Email (ML12030A004)	0055
Schott Cummins, Gretchen	Henderson Community College	Email (ML12025A144)	0015
Scott, Cathy		Email (ML12025A182)	0029
Severin, Patricia		Letter (ML12023A051)	0081
Shell, Karrie-Jo	U.S. Environmental Protection Agency, Region 4	Email (ML113610360)	0080

Table E-1. (contd)

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
Siler, Jill		Email (ML12025A206)	0040
Skeele, Michele and Skip		Email (ML12025A223)	0048
Sloan, Judie		Meeting Transcript (ML120260614)	0013-26
Sloss, Barbara		Email (ML12025A174)	0022
Smith, Coleman		Meeting Transcript (ML120260614)	0013-11
Smith, Joy		Email (ML12032A007)	0062
Smy, Gayle and Allison		Email (ML12025A129)	0002
Sorensen, Laura		Meeting Transcript (ML120260614)	0013-7
Sorensen, Ole		Letter (ML12039A143)	0102
Sorensen, Ole		Meeting Transcript (ML120260614)	0013-8
Southworth, Win		Email (ML12025A219)	0046
Spencer, Tim	Cherokee County Council	Meeting Transcript (ML120260614)	0013-3
Stanley, Joyce A.	U.S. Department of the Interior, Office of Environmental Policy & Compliance - Region 4	Letter (ML12068A363)	0141
Stoll, Irene		Email (ML12020A2711)	0001
Swing, Carol		Email (ML12025A183)	0030
Thomas Orengo, Cheryl		Email (ML12067A012)	0123
Thomas, Ellen		Letter (ML12039A130)	0089
Thomas, Ruth	Environmentalists, Inc.	Email (ML12067A008)	0119
Thomas, Ruth	Environmentalists, Inc.	Meeting Transcript (ML120260611)	0012-3
Tinnaro, Heather		Email (ML12025A134)	0007
Tinnaro, Heather		Meeting Transcript (ML120260614)	0013-9
Vejdani, Vivianne	SC Department of Natural Resources	Letter (ML12067A016)	0126
Vestal, Majorie		Email (ML)	0018
Vestal, Majorie		Email (ML12025A147)	0018
vonSeideneck-Houser, Rebecca		Email (ML12025A137)	0009

Table E-1. (contd)

Commenter	Affiliation (if stated)	Comment Source and ADAMS Accession #	Correspondence ID
Wallace, Kristine		Email (ML12067A010)	0121
Watters, Gillian		Email (ML12025A193)	0032
Whitefield, Anne		Email (ML12025A177)	0024
Whiteside, Cassie		Email (ML12025A205)	0039
Williams, David		Email (ML12067A007)	0118
Wilson, Dawn		Email (ML12067A009)	0120
Wilson, Rev. Mason and Barbara S.		Email (ML12025A143)	0014
Youngblood, Rob	York County Chamber of Commerce	Meeting Transcript (ML120260611)	0012-18
Zdenek, Dr. Joe		Meeting Transcript (ML120260614)	0013-16
Zeller, Lou	Blue Ridge Environmental Defense League	Email (ML12067A025)	0130
Zeller, Lou	Blue Ridge Environmental Defense League	Meeting Transcript (ML120260611)	0012-11

Table E-2 provides a list of commenters for each comment category. Within the comment category the commenters are identified by name and the specific comment identification number for that category is provided.

Table E-2. Comment Categories

Comment Category	Commenter (Comment ID)
Accidents-Severe	• Broadhead, Susan (0013-33-1) • Crissey, Brian (0012-8-2) • Fisk, Bill (0108-2) • Rose, Katherine (0113-7) • Schmitt, Brynn (0079-3) (0079-4) • Schmitt, Daniel (0116-4) • Sorensen, Laura (0013-7-2)
Alternatives-Energy	• Anonymous (0112-11) • Anonymous (0076-7) • Acs, Deborah (0107-1) • Adams, Rod (0012-12-2) (0012-12-5) (0012-12-6) (0013-12-2) (0013-12-4) (0013-12-6) • Allison, Patricia (0085-4) • Andrews, Josephine (0112-11) • Arnold, Debbie (0003-3)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Atanasoff, Mike (0078-3) • Beattie, Kathryn E. (0112-11) • Bertram, Beth (0044-3) • Bisesi, Philip (0013-31-2) • Bliss, Rachel (0013-13-2) (0104-3) • Boever, Virginia (0112-11) • Boots, Debby (0052-4) • Boyle, Ella (0112-11) • Broadhead, Susan (0083-4) (0083-6) (0098-4) • Brogan Prindle, Cathleen (0112-11) • Bromm, Bob (0013-18-3) • Burnett, Linda (0115-4) • Burt, Rick (0038-1) • Buscarino, John (0013-23-3) (0013-23-5) (0013-23-6) • Cahill, Joanne (0132-4) • Clere, Daniel (0125-2) • Connolly, Mary Ellen (0012-10-4) • Craig, Anne (0013-20-5) (0095-6) (0105-1) • Cranford, Kelley (0013-36-1) • Cremer, Claudine (0013-5-3) • Crissey, Brian (0012-8-1) (0012-8-3) (0117-8) (0117-11) • Cunningham, Kristine (0004-11) • da Silva, Arjuna (0063-3) (0063-8) • Davis, John (0112-11) • Dixon, Mary (0025-3) • Fallon, Chris (0134-69) (0134-70) • Farris, Mark (0012-16-2) • Fisk, Bill (0108-1) • Flaherty, David (0006-2) • Flores, S. (0112-11) • Gaddy, Ron (0054-2) (0054-4) • Gamble, Dan (0013-10-1) (0129-1) (0129-4) (0129-5) (0129-6) • Gardner, David (0035-2) • Gardner, Janet (0033-3) (0034-2) • Genetti, Phyllis (0110-2) • Gilbert, Grace (0077-4) • Greenberg, Lori (0099-2) • Greenburg, Lori (0013-29-2) • Hamahan, Clare (0112-11) • Hayes, MD, J. David (0124-4) (0124-6) • Hearne, Ray (0106-2) • Hicks, Katie (0012-7-8) • Holt, Cathy (0013-32-2) (0061-4)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Howarth, Irma (0092-6) • Howarth, Robert F. (0012-13-5) (0093-6) • Keil, A. Eugene (0112-11) • Knudten, Cori (0111-5) • Larson, Jean (0013-22-1) (0097-1) • Lauden, Loy (0047-6) • Lemoing, Melissa (0084-5) • Leverette, Will (0112-11) • Lewis, Brenda K. (0005-2) • Lovinsohn, Ruth (0114-12) • McAfee, Patricia B. (0143-3) • Nord, Felice (0027-5) • Norris, Steve (0013-21-1) • Patrie, MD, MPH, Lewis E. (0058-2) (0058-6) • Peterson, Harry (0112-11) • Peterson, Martha J. (0112-11) • Raleigh, Carolyn (0059-2) • Rawl, Otis (0012-5-3) • Reeser, Rachel (0043-1) • Reichenbach, Adam (0013-17-4) • Rhyne, Faith Rachel (0056-3) (0056-5) • Richards, Kitty Katherine (0013-28-1) • Rinsler, MD, Steve (0021-3) (0021-4) • Rittenberg, David (0112-11) • Rose, Katherine (0113-5) • Rustin, K. (0112-11) • Rylander, Kimchi (0086-4) • Sadler, Timothy (0013-25-1) • Schmitt, Daniel (0116-6) • Scott, Cathy (0029-2) • Severin, Patricia (0081-2) • Skeele, Michele and Skip (0048-9) • Sloss, Barbara (0022-4) • Smith, Joy (0062-3) • Southworth, Win (0046-1) • Stoll, Irene (0001-5) • Swing, Carol (0030-7) • Thomas Orengo, Cheryl (0123-3) • Thomas, Ellen (0089-4) • Thomas, Ruth (0119-13) • Tinnaro, Heather (0007-2) (0013-9-2) • Wallace, Kristine (0121-6) • Whitefield, Anne (0024-3)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Whiteside, Cassie (0039-1) • Wilson, Dawn (0120-3)
Alternatives-Sites	• Fallon, Chris (0134-4) (0134-71) (0134-78) (0134-84) (0134-85) • Kelly, Kitty (0008-1)
Alternatives-System Design	• Mueller, Heinz (0142-4) (0142-13) • Vejdani, Vivianne (0126-29)
Benefit-Cost Balance	• Anonymous (0112-10) • Anonymous (0076-6) • Adams, Rod (0012-12-3) • Andrews, Josephine (0112-10) • Beattie, Kathryn E. (0112-10) • Boever, Virginia (0112-10) • Boyle, Ella (0112-10) • Broadhead, Susan (0083-5) (0083-8) (0098-7) • Brogan Prindle, Cathleen (0112-10) • Cahill, Joanne (0132-5) • Christopher, Lucy D. (0133-4) • Crissey, Brian (0012-8-4) (0012-8-6) (0012-8-7) (0117-5) (0117-6) (0117-10) • Cunningham, Kristine (0004-10) • da Silva, Arjuna (0063-7) • Davis, John (0112-10) • Doebber, Ian (0026-4) • Doebber, Rachel (0026-4) • Doebber, Tom (0019-5) • Fallon, Chris (0013-4-3) (0134-87) • Flores, S. (0112-10) • G., Edith A. (0140-2) • Gardner, David (0035-1) • Gossett, Lewis (0012-9-3) • Hamahan, Clare (0112-10) • Howarth, Robert F. (0012-13-1) (0012-13-3) (0012-13-4) (0093-1) (0093-3) (0093-4) (0093-5) • Justice, Cynthia and Michael (0122-4) • Karpen, Leah R. (0082-3) • Keil, A. Eugene (0112-10) • Klein, Art and Michelle (0020-5) • Lauden, Loy (0047-3) • Leverette, Will (0112-10) • Lewis, Brenda K. (0005-3) • McMahon, John (0041-6) • Morgan, Tom and Barbara (0017-7) • Oehler, Susan (0051-4)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Patrie, MD, MPH, Lewis E. (0058-1) • Peterson, Harry (0112-10) • Peterson, Martha J. (0112-10) • Rhyne, Faith Rachel (0056-2) • Richardson, Don (0100-5) • Rinsler, MD, Steve (0021-5) • Rittenberg, David (0112-10) • Rustin, K. (0112-10) • Schmitt, Daniel (0116-5) • Schneyer, Julie (0055-3) • Skeele, Michele and Skip (0048-6) • Sloan, Judie (0013-26-1) • Sloss, Barbara (0022-2) • Smith, Coleman (0013-11-7) • Smy, Gayle and Allison (0002-4) • Southworth, Win (0046-3) • Stoll, Irene (0001-4) • Swing, Carol (0030-6) • Thomas, Ruth (0119-1) (0119-12) (0119-19) (0119-20) • Whitefield, Anne (0024-1) (0024-6)
Cumulative Impacts	• Mueller, Heinz (0142-25)
Ecology-Aquatic	• Caldwell, Mark (0141-1) (0141-4) (0141-5) (0141-7) (0141-8) (0141-9) • Conard, Sky (0012-4-2) (0094-2) • Craig, Anne (0013-20-3) (0095-4) • Fallon, Chris (0134-8) (0134-9) (0134-10) (0134-43) (0134-44) (0134-45) (0134-52) (0134-53) (0134-62) (0134-63) (0134-64) (0134-73) • Gregg, Ben (0135-4) • Hicks, Katie (0012-7-6) (0012-7-11) • Larsen Clark, Brita (0012-15-3) • Lovinsohn, Ruth (0114-5) • Morgan, Tom and Barbara (0017-6) • Mueller, Heinz (0142-11) (0142-16) • Skeele, Michele and Skip (0048-5) • Stanley, Joyce A. (0141-1) (0141-4) (0141-5) (0141-7) (0141-8) (0141-9) • Thomas, Ruth (0119-5) • Vejdani, Vivianne (0126-12) (0126-13) (0126-14) (0126-15) (0126-31) (0126-34) • Zeller, Lou (0130-3)
Ecology-Terrestrial	• Caldwell, Mark (0141-2) • Fallon, Chris (0134-1) (0134-7) (0134-28) (0134-29) (0134-30) (0134-31) (0134-32) (0134-33) (0134-34) (0134-35) (0134-36) (0134-37) (0134-38) (0134-39) (0134-40) (0134-41) (0134-42) (0134-58) (0134-59) (0134-60) (0134-61) (0134-81) (0134-82)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Gregg, Ben (0135-3) (0135-5) • Lauden, Loy (0047-5) • Mueller, Heinz (0142-10) (0142-12) (0142-14) (0142-24) • Stanley, Joyce A. (0141-2) • Thomas, Ruth (0119-4) (0119-6) • Vejdani, Vivianne (0126-1) (0126-4) (0126-5) (0126-6) (0126-7) (0126-8) (0126-9) (0126-10) (0126-11) (0126-16) (0126-17) (0126-19) (0126-21) (0126-22) (0126-25) (0126-28) (0126-30) (0126-32) (0126-33)
Editorial Comments	• Fallon, Chris (0134-48) (0134-56) (0134-57)
Environmental Justice	• Fallon, Chris (0134-54) • Hicks, Katie (0012-7-5) (0012-7-7) • Mueller, Heinz (0142-22)
Health-Nonradiological	• Fallon, Chris (0134-83) • Mueller, Heinz (0142-20)
Health-Radiological	• Anonymous (0112-2) (0112-6) • Acs, Deborah (0107-2) • Andrews, Josephine (0112-2) (0112-6) • Beattie, Kathryn E. (0112-2) (0112-6) • Bisesi, Philip (0013-31-1) • Boever, Virginia (0112-2) (0112-6) • Boyle, Ella (0112-2) (0112-6) • Broadhead, Susan (0013-33-2) (0083-2) (0083-3) (0098-2) (0098-3) • Brockington, Mary Sue and William B. (0144-2) • Brogan Prindle, Cathleen (0112-2) (0112-6) • Bromm, Bob (0013-18-1) • Christopher, Lucy D. (0133-8) • Craig, Tom (0060-1) • Cunningham, Kristine (0004-5) • Davis, John (0112-2) (0112-6) • Dixon, Mary (0025-2) • Drouin, Michaeljon (0087-1) • Fallon, Chris (0134-65) • Flores, S. (0112-2) (0112-6) • Glaser, Christine (0031-1) • Greenberg, Lori (0099-1) • Greenburg, Lori (0013-29-1) • Hamahan, Clare (0112-2) (0112-6) • Holt, Cathy (0061-3) • Howarth, Irma (0012-19-1) (0092-2) • Howarth, Robert F. (0093-2) • Karpen, Leah R. (0082-1) • Keil, A. Eugene (0112-2) (0112-6) • Knudten, Cori (0111-3)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Larsen Clark, Brita (0012-15-1) • Leverette, Will (0112-2) (0112-6) • Lovinsohn, Ruth (0114-7) (0114-10) • McMahon, John (0041-2) (0041-4) • Morgan, Tom and Barbara (0017-1) (0017-2) • Mueller, Heinz (0142-6) (0142-8) • Patrie, MD, MPH, Lewis E. (0058-4) • Peterson, Harry (0112-2) (0112-6) • Peterson, Martha J. (0112-2) (0112-6) • Richardson, Don (0013-14-2) (0100-1) • Rittenberg, David (0112-2) (0112-6) • Rustin, K. (0112-2) (0112-6) • Skeele, Michele and Skip (0048-1) (0048-2) • Thomas, Ruth (0119-17) (0119-23) • Vestal, Majorie (0018-2) (0018-4) • Zdenek, Dr. Joe (0013-16-3) • Zeller, Lou (0012-11-1) (0012-11-3) (0130-8) (0130-10)
Historic and Cultural Resources	• Dobrasko, Rebekah (0109-1) • Fallon, Chris (0134-46) (0134-47) (0134-55) (0134-77) (0134-88) • Mueller, Heinz (0142-26) (0142-32)
Hydrology-Groundwater	• Fallon, Chris (0134-6)
Hydrology-Surface Water	• Anonymous (0112-4) (0112-7) • Allison, Patricia (0085-3) • Andrews, Josephine (0112-4) (0112-7) • Beattie, Kathryn E. (0112-4) (0112-7) • Bliss, Rachel (0013-13-3) (0104-5) • Boever, Virginia (0112-4) (0112-7) • Boyle, Ella (0112-4) (0112-7) • Broadhead, Susan (0083-7) (0098-5) (0098-6) • Brogan Prindle, Cathleen (0112-4) (0112-7) • Buscarino, John (0013-23-4) • Cahill, Joanne (0132-6) • Caldwell, Mark (0141-3) (0141-6) • Christopher, Lucy D. (0133-3) • Conard, Sky (0012-4-3) (0012-4-4) (0012-4-5) (0094-1) (0094-3) (0127-1) • Connolly, Mary Ellen (0012-10-1) • Craig, Anne (0013-20-2) (0013-20-4) (0095-3) (0095-5) • Cremer, Claudine (0013-5-4) (0013-5-5) • Cunningham, Kristine (0004-3) (0004-7) • Davis, John (0112-4) (0112-7) • Doebber, Ian (0026-3) • Doebber, Rachel (0026-3)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Doebber, Tom (0019-4) • Fallon, Chris (0134-26) (0134-27) (0134-51) (0134-72) • Flores, S. (0112-4) (0112-7) • Gamble, Dan (0129-2) • Gregg, Ben (0135-1) (0135-2) (0135-6) • Hamahan, Clare (0112-4) (0112-7) • Hayes, MD, J. David (0124-2) • Hicks, Katie (0012-7-2) (0012-7-4) (0012-7-9) (0012-7-10) (0012-7-12) • Howarth, Robert F. (0093-7) • Justice, Cynthia and Michael (0122-5) • Karpen, Leah R. (0082-2) • Keil, A. Eugene (0112-4) (0112-7) • Klein, Art and Michelle (0020-4) • Larsen Clark, Brita (0012-15-4) • Larson, Jean (0097-2) • Lauden, Loy (0047-2) • Lemoing, Melissa (0084-4) • Leverette, Will (0112-4) (0112-7) • Lovinsohn, Ruth (0114-6) • Mayfield, Julie (0128-1) (0128-2) (0128-3) (0128-4) (0128-5) • McWherter, Lisa (0013-30-2) (0013-30-3) • Morgan, Tom and Barbara (0017-3) (0017-5) • Mueller, Heinz (0142-15) (0142-17) (0142-30) • Peterson, Harry (0112-4) (0112-7) • Peterson, Martha J. (0112-4) (0112-7) • Raleigh, Carolyn (0059-3) • Reeser, Rachel (0043-3) • Rittenberg, David (0112-4) (0112-7) • Rustin, K. (0112-4) (0112-7) • Rylander, Kimchi (0086-2) • Shell, Karrie-Jo (0080-1) • Skeele, Michele and Skip (0048-4) • Sloss, Barbara (0022-3) • Smith, Coleman (0013-11-5) • Southworth, Win (0046-2) • Stanley, Joyce A. (0141-3) (0141-6) • Stoll, Irene (0001-3) • Swing, Carol (0030-2) • Thomas, Ruth (0119-26) (0119-27) • Vejdani, Vivianne (0126-3) (0126-23) (0126-26) (0126-27) • Whitefield, Anne (0024-4) • Whiteside, Cassie (0039-3) • Zeller, Lou (0130-4) (0130-5) (0130-6) (0130-12)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
Land Use-Site and Vicinity	• Fallon, Chris (0134-5) (0134-23) (0134-24) (0134-25) (0134-49) (0134-50) (0134-79) (0134-80) (0134-86) • Sorensen, Laura (0013-7-3) • Vejdani, Vivianne (0126-2) (0126-20) (0126-24)
Meteorology and Air Quality	• Allison, Patricia (0085-2) • Fallon, Chris (0134-66) • Howarth, Robert F. (0012-13-2) • McWherter, Lisa (0013-30-1) • Moss, Representative Dennis (0013-1-4) • Mueller, Heinz (0142-18) (0142-19) (0142-28) (0142-29) (0142-31) • Thomas, Ruth (0119-22) • Wallace, Kristine (0121-3) • Zeller, Lou (0130-2)
Need for Power	• Boger, Paul (0012-14-2) • Boots, Debby (0052-2) • Fallon, Chris (0013-4-1) (0134-3) (0134-67) (0134-68) • Farris, Mark (0012-16-3) • Gossett, Lewis (0012-9-1) (0012-9-2) (0012-9-4) • Jamil, Dhiaa (0012-2-1) • Moss, Representative Dennis (0013-1-2) • Rawl, Otis (0012-5-2)
Nonradiological Waste	• Mueller, Heinz (0142-27)
Opposition-Licensing Action	• Anonymous (0112-3) • Anonymous (0076-1) • Allison, Patricia (0085-1) • Andrews, Josephine (0112-3) • Arnold, Debbie (0003-1) (0003-4) • Beattie, Kathryn E. (0112-3) • Bliss, Rachel (0104-2) (0104-6) • Boever, Virginia (0112-3) • Boots, Debby (0052-1) (0052-3) • Boyle, Ella (0112-3) • Brackett, Cheri (0023-1) • Broadhead, Susan (0013-33-3) (0083-1) (0083-10) (0098-1) • Brogan Prindle, Cathleen (0112-3) • Burnett, Linda (0115-1) (0115-3) • Cahill, Joanne (0132-1) (0132-7) • Christopher, Lucy D. (0133-1) • Clere, Daniel (0125-1) (0125-3) • Craig, Anne (0105-2) • Craig, Tom (0060-2) • Cranford, Kelley (0013-36-2)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Cunningham, Kristine (0004-2) • da Silva, Arjuna (0063-1) • Dailey, Debbie (0139-1) (0139-4) • Davis, John (0112-3) • Dixon, Mary (0025-1) (0025-4) • Doebber, Tom (0019-1) (0019-7) • Fisk, Bill (0108-3) • Flaherty, David (0006-1) • Flores, S. (0112-3) • G., Edith A. (0140-1) (0140-4) • Gardner, Janet (0033-1) • Gilbert, Grace (0077-3) (0077-5) • Greenberg, Lori (0099-4) • Hamahan, Clare (0112-3) • Hayes, MD, J. David (0124-1) (0124-7) • Howell, Martha N. (0016-1) (0016-2) • Justice, Cynthia and Michael (0122-1) • Keil, A. Eugene (0112-3) • Klein, Art and Michelle (0020-1) (0020-7) • Lemoing, Melissa (0084-1) • Leverette, Will (0112-3) • Lovinsohn, Ruth (0088-1) (0114-1) • Macko, Karl (0145-1) • McAfee, Patricia B. (0143-1) • McMahon, John (0041-1) • Mewborne, Janice (0045-1) • Miller, John C. (0011-1) • Morgan, Tom and Barbara (0017-11) • Nord, Felice (0027-1) • Oehler, Susan (0051-1) • Peterson, Harry (0112-3) • Peterson, Martha J. (0112-3) • Raleigh, Carolyn (0059-1) • Rhyne, Faith Rachel (0056-1) • Rinsler, MD, Steve (0021-1) • Rittenberg, David (0112-3) • Rose, Katherine (0113-1) • Rustin, K. (0112-3) • Ruthye100, You Tube Service (0049-1) • Schmitt, Brynn (0079-1) • Schmitt, Daniel (0116-1) • Schneyer, Julie (0055-1) • Schott Cummins, Gretchen (0015-1)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Severin, Patricia (0081-1) • Siler, Jill (0040-1) • Smith, Joy (0062-1) • Smy, Gayle and Allison (0002-1) (0002-3) (0002-5) • Southworth, Win (0046-5) • Stoll, Irene (0001-1) • Swing, Carol (0030-1) • Thomas Orengo, Cheryl (0123-1) (0123-2) • Thomas, Ellen (0089-1) • Thomas, Ruth (0119-25) • Tinnaro, Heather (0007-3) • Vestal, Majorie (0018-1) • vonSeideneck-Houser, Rebecca (0009-1) • Williams, David (0118-1) • Wilson, Dawn (0120-1) • Wilson, Rev. Mason and Barbara S. (0014-1) • Zdenek, Dr. Joe (0013-16-1)
Opposition-Licensing Process	• Nord, Felice (0027-2) • Smith, Coleman (0013-11-1) • Thomas, Ellen (0089-3) • Wallace, Kristine (0121-5)
Opposition-Nuclear Power	• Anonymous (0112-1) • Anonymous (0076-2) • Acs, Deborah (0107-4) • Andrews, Josephine (0112-1) • Arnold, Debbie (0003-2) • Atanasoff, Mike (0078-1) (0078-2) • Beattie, Kathryn E. (0112-1) • Bertram, Beth (0044-1) • Bliss, Rachel (0104-4) (0104-7) • Boever, Virginia (0112-1) • Boyle, Ella (0112-1) • Brogan Prindle, Cathleen (0112-1) • Burt, Rick (0038-2) • Buscarino, John (0013-23-1) • Christopher, Lucy D. (0133-2) • Collins, Richard (0037-1) (0037-3) • Craig, Anne (0013-20-1) (0095-1) (0095-2) (0105-3) • Crissey, Brian (0117-2) • Cunningham, Kristine (0004-1) • da Silva, Arjuna (0063-2) (0063-4) (0063-5) • Davis, John (0112-1) • DeLap, E.A. (0057-1)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Doebber, Ian (0026-1) • Doebber, Rachel (0026-1) • Doebber, Tom (0019-2) • Flores, S. (0112-1) • Gardner, Janet (0033-2) (0034-1) • Genetti, Phyllis (0110-1) (0110-3) • Greenberg, Lori (0099-3) • Hamahan, Clare (0112-1) • Hammett, Jan (0013-35-2) • Hicks, Katie (0012-7-1) • Holt, Cathy (0061-1) (0061-2) • Howarth, Irma (0012-19-4) (0012-19-5) • Keil, A. Eugene (0112-1) • Klein, Art and Michelle (0020-2) • Knudten, Cori (0111-2) • Lauden, Loy (0047-1) • Leverette, Will (0112-1) • Lewis, Brenda K. (0005-1) • Lovinsohn, Ruth (0114-2) (0114-4) • Nord, Felice (0027-3) (0027-4) • Norris, Steve (0013-21-2) • Oehler, Susan (0051-2) • Peterson, Harry (0112-1) • Peterson, Martha J. (0112-1) • Reeser, Rachel (0043-2) • Rhyne, Faith Rachel (0056-6) • Richardson, Don (0013-14-1) (0013-14-4) • Rittenberg, David (0112-1) • Rose, Katherine (0113-3) • Rustin, K. (0112-1) • Schmitt, Brynn (0079-5) • Schmitt, Daniel (0116-2) • Schneyer, Julie (0055-2) • Scott, Cathy (0029-1) • Skeele, Michele and Skip (0048-11) • Smith, Coleman (0013-11-2) (0013-11-3) (0013-11-8) • Smith, Joy (0062-2) • Smy, Gayle and Allison (0002-2) • Sorensen, Laura (0013-7-5) • Sorensen, Ole (0013-8-1) • Stoll, Irene (0001-2) • Swing, Carol (0030-3) • Thomas, Ellen (0089-2)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Thomas, Ruth (0012-3-3) • Tinnaro, Heather (0007-1) • Wallace, Kristine (0121-1) • Watters, Gillian (0032-1) • Whiteside, Cassie (0039-2) • Wilson, Rev. Mason and Barbara S. (0014-3) • Zdenek, Dr. Joe (0013-16-2) • Zeller, Lou (0012-11-4)
Outside Scope-Emergency Preparedness	• Sorensen, Laura (0013-7-1) • Thomas, Ruth (0119-11) (0119-16) • Vestal, Majorie (0018-3)
Outside Scope-Miscellaneous	• Crissey, Brian (0117-7) (0117-9) • Gamble, Dan (0129-3) • Skeele, Michele and Skip (0048-7) • Thomas, Ruth (0119-10) • Zeller, Lou (0130-9) (0130-11)
Outside Scope-NRC Oversight	• Anonymous (0076-3) (0076-5) • Connolly, Mary Ellen (0012-10-5) • Knudten, Cori (0111-4) • Lovinsohn, Ruth (0088-2) (0114-13) • Thomas, Ruth (0119-14)
Outside Scope-Safety	• Anonymous (0112-9) • Andrews, Josephine (0112-9) • Beattie, Kathryn E. (0112-9) • Bliss, Rachel (0013-13-1) (0013-13-6) (0104-1) (0104-8) (0104-9) • Boever, Virginia (0112-9) • Boyle, Ella (0112-9) • Brogan Prindle, Cathleen (0112-9) • Cahill, Joanne (0132-2) (0132-3) • Christopher, Lucy D. (0133-6) • Connolly, Mary Ellen (0012-10-2) (0012-10-7) • Cremer, Claudine (0013-5-1) (0013-5-2) • Crissey, Brian (0012-8-5) • Cunningham, Kristine (0004-9) • Dailey, Debbie (0013-19-1) (0139-3) • Davis, John (0112-9) • Doebber, Ian (0026-5) • Doebber, Rachel (0026-5) • Doebber, Tom (0019-6) • Fisk, Bill (0013-27-1) • Flores, S. (0112-9) • G., Edith A. (0140-3)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Guy, Peggy (0013-15-1) • Hamahan, Clare (0112-9) • Hearne, Ray (0013-24-1) (0106-1) • Howarth, Irma (0092-5) • Justice, Cynthia and Michael (0122-2) (0122-6) • Keil, A. Eugene (0112-9) • Klein, Art and Michelle (0020-6) • Knudten, Cori (0111-1) • Lemoing, Melissa (0084-3) • Leverette, Will (0112-9) • Lovinsohn, Ruth (0114-11) • McAfee, Patricia B. (0143-2) • Morgan, Tom and Barbara (0017-4) (0017-10) • Mueller, Heinz (0142-7) • Peterson, Harry (0112-9) • Peterson, Martha J. (0112-9) • Richardson, Don (0013-14-3) (0100-2) (0100-3) (0100-4) • Rinsler, MD, Steve (0021-7) (0021-8) • Rittenberg, David (0112-9) • Rose, Katherine (0113-2) (0113-6) • Rustin, K. (0112-9) • Ruthye100, You Tube Service (0049-2) • Skeele, Michele and Skip (0048-3) • Sloan, Judie (0013-26-2) • Sorensen, Laura (0013-7-4) • Southworth, Win (0046-4) • Swing, Carol (0030-4) (0030-5) • Thomas, Ruth (0119-2) (0119-3) (0119-21) • Zeller, Lou (0012-11-2) (0130-1) (0130-7)
Outside Scope-Security and Terrorism	• Dailey, Debbie (0013-19-2) • Doebber, Ian (0026-2) • Doebber, Rachel (0026-2) • Doebber, Tom (0019-3) • Hayes, MD, J. David (0124-5) • Klein, Art and Michelle (0020-3) • Thomas, Ruth (0119-15) (0119-24) • Whitefield, Anne (0024-5)
Process-ESP-COL	• Mueller, Heinz (0142-3) (0142-9) • Thomas, Ruth (0119-18)
Process-NEPA	• Brockington, Mary Sue and William B. (0144-1) • Mayfield, Julie (0128-6) • Rinsler, MD, Steve (0021-6)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
Site Layout and Design	• Fallon, Chris (0134-2) (0134-12) (0134-13) (0134-14) (0134-15) (0134-16) (0134-17) (0134-18) (0134-19) (0134-20) (0134-21) (0134-22)
Socioeconomics	• Beach, William (0013-34-1) • Boger, Paul (0012-14-1) (0012-14-3) • Bromm, Bob (0013-18-2) • Buscarino, John (0013-23-2) • Conard, Sky (0012-4-1) • Cook, Jim (0012-17-1) • Crissey, Brian (0117-1) • Fallon, Chris (0013-4-2) (0134-11) (0134-74) (0134-75) (0134-76) • Farris, Mark (0012-16-1) • Gaddy, Ron (0054-3) • Gossett, Lewis (0012-9-6) • Hammett, Jan (0013-35-1) • Jamil, Dhiaa (0012-2-2) • Lovinsohn, Ruth (0114-8) • Moss, Representative Dennis (0013-1-3) • Moss, Representative Steve (0013-2-3) • Mueller, Heinz (0142-21) (0142-23) • Patrie, MD, MPH, Lewis E. (0058-3) • Rawl, Otis (0012-5-4) (0012-5-5) • Reichenbach, Adam (0013-17-2) • Richardson, Don (0100-6) • Vejdani, Vivianne (0126-18) • Youngblood, Rob (0012-18-2)
Support-Licensing Action	• Cook, Jim (0012-17-2) • Cox, Judith (0010-1) • Fallon, Chris (0013-4-4) • Farris, Mark (0012-16-4) • Gossett, Lewis (0012-9-5) • Jamil, Dhiaa (0012-2-3) (0012-2-4) • McFadden, Cindy (0091-1) • Moss, Representative Steve (0013-2-1) (0013-2-2) (0013-2-5) • Rawl, Otis (0012-5-1) (0012-5-6) • Reichenbach, Adam (0013-17-1) (0013-17-3) • Richardson, Ed (0036-1) • Spencer, Tim (0013-3-1) • Youngblood, Rob (0012-18-1) (0012-18-3)
Support-Nuclear Power	• Adams, Rod (0012-12-7) (0013-12-1) (0013-12-3) (0013-12-5) • Baker, Kasey (0013-6-1) • Gaddy, Ron (0054-1) (0054-5) • Moss, Representative Dennis (0013-1-1) (0013-1-5) • Paterson, Wallace (0042-1)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
Transportation	• Howarth, Irma (0012-19-2) (0092-3) • Thomas, Ruth (0119-9)
Uranium Fuel Cycle	• Anonymous (0112-5) (0112-8) (0137-1) • Anonymous (0076-4) • Acs, Deborah (0107-3) • Adams, Rod (0012-12-1) (0012-12-4) • Allison, Patricia (0085-5) • Andrews, Josephine (0112-5) (0112-8) • Apunte, Daya (0131-1) • Beattie, Kathryn E. (0112-5) (0112-8) • Bertram, Beth (0044-2) • Bliss, Rachel (0013-13-4) (0013-13-5) (0104-10) (0104-11) • Boever, Virginia (0112-5) (0112-8) • Boyle, Ella (0112-5) (0112-8) • Broadhead, Susan (0083-9) (0098-8) • Brogan Prindle, Cathleen (0112-5) (0112-8) • Burnett, Linda (0115-2) • Christopher, Lucy D. (0133-5) (0133-7) • Collins, Richard (0037-2) • Connolly, Mary Ellen (0012-10-3) (0012-10-6) • Crissey, Brian (0117-3) (0117-4) • Cunningham, Kristine (0004-4) (0004-8) • da Silva, Arjuna (0063-6) • Dailey, Debbie (0013-19-3) (0139-2) • Davis, John (0112-5) (0112-8) • Doebber, Ian (0026-6) (0026-7) • Doebber, Rachel (0026-6) (0026-7) • Doebber, Tom (0019-8) (0019-9) • Flores, S. (0112-5) (0112-8) • Gilbert, Grace (0077-1) (0077-2) • Gilman, Steve (0012-6-1) • Hamahan, Clare (0112-5) (0112-8) • Hayes, MD, J. David (0124-3) • Hicks, Katie (0012-7-3) • Holt, Cathy (0013-32-1) • Howarth, Irma (0012-19-3) (0092-1) (0092-4) • Justice, Cynthia and Michael (0122-3) • Karpen, Leah R. (0082-4) (0082-5) • Keil, A. Eugene (0112-5) (0112-8) • Klein, Art and Michelle (0020-8) (0020-9) • Larsen Clark, Brita (0012-15-2) • Lauden, Loy (0047-4) • Lemoing, Melissa (0084-2)

Table E-2. (contd)

Comment Category	Commenter (Comment ID)
	• Leverette, Will (0112-5) (0112-8) • Lovinsohn, Ruth (0114-3) (0114-9) • McMahon, John (0041-3) (0041-5) • Morgan, Tom and Barbara (0017-8) (0017-9) • Mueller, Heinz (0142-1) (0142-2) (0142-5) • Oehler, Susan (0051-3) • Patrie, MD, MPH, Lewis E. (0058-5) • Peterson, Harry (0112-5) (0112-8) • Peterson, Martha J. (0112-5) (0112-8) • Raleigh, Carolyn (0059-4) • Reeser, Rachel (0043-4) • Rhyne, Faith Rachel (0056-4) • Rinsler, MD, Steve (0021-2) • Rittenberg, David (0112-5) (0112-8) • Rose, Katherine (0113-4) • Rustin, K. (0112-5) (0112-8) • Rylander, Kimchi (0086-1) (0086-3) • Schmitt, Brynn (0079-2) • Schmitt, Daniel (0116-3) • Skeele, Michele and Skip (0048-8) (0048-10) • Sloan, Judie (0013-26-3) • Sloss, Barbara (0022-1) • Smith, Coleman (0013-11-4) (0013-11-6) • Southworth, Win (0046-6) (0046-7) • Thomas, Ruth (0012-3-1) (0012-3-2) (0119-7) (0119-8) • Tinnaro, Heather (0013-9-1) • Wallace, Kristine (0121-2) (0121-4) • Whitefield, Anne (0024-2) • Whiteside, Cassie (0039-4) • Wilson, Dawn (0120-2) • Wilson, Rev. Mason and Barbara S. (0014-2)

E.2 Comments and Responses

Table E-3 is a list of the comment categories included in this appendix in the order in which they appear. The balance of this document presents the comments and responses organized by topic category. References appear in Section E.3 at the end of the appendix.

Table E-3. Comment Categories in Order of Presentation

E.2.1 Comments Concerning the COL Process

Comment: The problem that Duke Energy proceeds with pre-construction activities such as clearing land, cutting trees, evicting residents, digging ponds, while the plant is still only under consideration. These activities should stop. (**0119-18** [Thomas, Ruth])

Response: *This comment addresses preconstruction activities at the Lee Nuclear Station site. Activities that do not fall within the NRC's definition of construction in Title 10 of the* Code of Federal Regulations *(CFR) 50.10(a) and 51.4, such as clearing and grading, excavating, building transmission lines, erecting support buildings, and building supplemental cooling-water reservoirs, are considered "preconstruction" activities that do not require NRC authorization. Most of these activities are regulated by other local, State, Tribal, or Federal agencies and require permits from them to proceed (e.g., a permit from the USACE is required for preconstruction activities that could affect waters of the United States). Based on its regulations, the NRC considers preconstruction activities in environmental reviews in the context of cumulative impacts. These impacts are evaluated in Chapters 4 and 7 of the EIS. No change was made to the EIS as a result of this comment.*

Comment: *Transmission lines*

The project calls for four new transmission lines (two 230-kV and two 525-kV lines) to be constructed to accommodate the new power generating capacity (page 5-63). We note that the NRC considers transmission lines to be "preconstruction" activities, and that preconstruction activities are considered in the context of cumulative impacts. EPA is concerned about the impacts of transmission lines and supporting infrastructure for the project and, in accordance with NEPA, considers these activities as part of the project, and not a separate action.

Recommendations: The FEIS should clarify whether there are plans to issue a Limited Work Authorization (LWA) for these lines pursuant to the NRC's LWA process. (**0142-9** [Mueller, Heinz])

Response: *The commenter is correct in that building of service facilities, such as paved roads, parking lots, railroad spurs, exterior utility and lighting systems, potable-water systems, sanitary waste-treatment facilities, and transmission lines are preconstruction activities that do not require permits from the NRC. Therefore transmission lines and supporting infrastructure can be constructed at any time—before, during, or after the issuance of any NRC permit or license. These activities would not require a Limited Work Authorization (LWA) from the NRC. LWAs are only needed for activities that affect specific safety-related structures, systems, and components that are relied upon to remain functional during and following specific events that the facility is designed to handle. Transmission lines are not considered to be safety-related structures. However, preconstruction activities may require permits from other Federal and State agencies (e.g., permits from the USACE if wetlands are affected or if dredging is needed under Section 404 of the Clean Water Act [CWA], and from the South Carolina Department of*

Health and Environmental Control [SCDHEC] for Section 401 Water Quality Certification and National Pollutant Discharge Elimination System [NPDES] permits, also required under the CWA). The NRC and the USACE signed a memorandum of understanding (MOU) in which the agencies agreed that the USACE will be a cooperating agency. The USACE will require issuance of a final EIS prior to making any permit decision allowing preconstruction activities that impact wetlands. Therefore, prior to preconstruction activities, the NRC has encouraged Duke to consult with the appropriate State and Federal regulatory bodies that have authority over preconstruction activities. No change was made to the EIS as a result of this comment.

Comment: We appreciate the inclusion of mitigation strategies for environmental impact categories and socioeconomic, EJ, and cultural resource impacts in the DEIS (Table 4-6). Table 4-6 lists specific measures and controls to avoid and minimize construction impacts, and we also note that there is also a specific requirement for a compensatory mitigation plan that complies with Section 404(b)(1) Guidelines. EPA reviewed the Joint Public Notice (JPN) and submitted comments regarding the compensatory mitigation and permit action under separate cover on March 6, 2012 (see enclosed letter to USACE). We recommend that clear commitments be provided regarding mitigation measures and public outreach methods mentioned for all media issues in the DEIS and Environmental Report (ER) in the decision documents.
(**0142-3** [Mueller, Heinz])

Response: *Table 4-6 of the EIS lists mitigation measures by resource area. Other Federal and State agencies have the regulatory mechanisms to require clear mitigation commitments with respect to certain environmental matters, but the NRC lacks such statutory authority when mitigation is unrelated to radiological health and safety matters. Implementation of potential mitigation measures listed in the EIS will be at the discretion of Duke, unless required to satisfy a particular permit. The USACE will ensure that mitigation, including compensatory mitigation, required for any Department of the Army permit, if issued, meets its program requirements. A summary of Duke's mitigation plan, as provided by the USACE, is included in Section 4.3.1.7 of the EIS. With regard to public outreach, both the NRC and the USACE have conducted public meetings and issued public notices regarding the proposed action and Duke's permit applications, and upon issuance of the final EIS, public notices will again be issued. Duke's mitigation work in the Turkey Creek tract and in the Sumter National Forest may involve some level of public outreach; however, such outreach will be at the discretion of Duke, unless otherwise required by the USACE or the U.S. Forest Service. No change was made to the EIS as a result of this comment.*

E.2.2 Comments Concerning the NEPA Process

Comment: Adequate public review should include meetings in locations convenient to the putative users AND ANY OTHERS AFFECTED BY the operation of the proposed power plant. Notice of such public meetings should be widely publicized in clear, nontechnical language via multiple mass-media sources to enable attendance and input by all putative users of the proposed power plant. Such notice should be published long enough before the day of the meetings to maximize the attendance by interested individuals. Input for the meetings should be sought be recognized experts in environment hazards due to nuclear fuel and radiation WITHOUT ties to the nuclear power industry or the company proposing the power plant. (**0021-6** [Rinsler, MD, Steve])

Comment: I live on Victory Trail Road in Gaffney not far from the proposed Nuclear Plant. I was just today made aware at approx 3 oclock in the afternoon that there had been meetings concerning the plant being opened. No one has ever consulted anyone in my household, told us of any meetings concerning this matter and now I find that Duke Power officials have said that there have been no objections in meetings we were not informed of! Why were the residents of Victory Trail, Darby Rd, Edward Rd, Old Barn Road, Grace Road, Jimmy Road and Whites Road not informed of meetings. I am writing on behalf of the many people who do not know who to object to is the only reason they have not been heard. (**0144-1** [Brockington, Mary Sue and William B.])

Response: *The comments address concerns regarding the NRC's notice of the Lee Nuclear Station project and subsequent public meetings and public participation. In particular, the second comment expresses opposition against the proposed action on behalf of the commenter and residents in the immediate vicinity of the Lee Nuclear Station site. Unfortunately the commenter was not part of the four public meetings or two scoping periods that were conducted for the Lee Nuclear Station environmental review since 2007. However, the commenter's opposition is noted and is now part of the environmental review's administrative record.*

It is the policy of the NRC to involve the public in the Commission's decision-making process; therefore, although not required by NEPA, the NRC elects to conduct open public meetings in association with its environmental review process. Meetings are generally held in a location accessible by the largest population that will experience the most direct environmental impact as a result of the proposed action. In the case of the proposed Lee Nuclear Station, this population is located in the area of Gaffney, South Carolina. The NRC has held four public meetings in Gaffney, South Carolina, regarding the proposed Lee Nuclear Station: August 2007, May 2008, June 2010, and January 2012. There were two public scoping periods: an initial scoping period for 60 days from May through June, 2008 and a supplemental scoping period from May through July, 2010. Prior to all four of the NRC's public meetings, press releases and meeting notices were issued, and advertisements were placed in local South Carolina and North Carolina newspapers. For the most recent public meeting in January 2012, the NRC chose to publish newspaper advertisements only in South Carolina. This was because numerous North Carolina residents had registered ahead of time to speak at the public meetings and the NRC was aware of notifications regarding the meetings posted by North Carolina activist groups. The NRC placed advertisements in the Abbeville Press & Banner, the Anderson Independent-Mail, *the Belton News-Chronicle, the Blacksburg Times, the Boiling Spring Sentry, the Chesnee Tribune, the Clemson Daily Messenger, the Clinton Chronicle, the Cowpens/Spartanburg County News, the Easley Progress, the Gaffney Ledger, the Greenville LINK, the Greenville News, the Greenwood Index-Journal, the Greer Citizen, the Inman Times, the Landrum News Leader, the Laurens County Advertiser, the Lyman Middle Tyger Times, the Pickens County Courier, the Pickens Sentinel, the Powdersville Post, the Seneca Daily Journal, the Simpsonville Tribune-Times, the Spartanburg Herald-Journal, the Travelers Rest Monitor, the Union Daily Times, the Walhalla Keowee Courier, the Westminster News, the Williamston Journal, and the Woodruff News. The advertisements and press releases were written in plain language explaining the time, date, and location of the meetings, and how to register for the meetings and submit comments on the environmental review and the EIS. The advertisements also listed the environmental project manager, Ms. Sarah Lopas, as the point of contact for the Lee Nuclear Station environmental review.*

The purpose of the NRC's public meetings is to allow members of the public to express their concerns and opinions regarding the proposed plant and ask questions of NRC staff, and for NRC staff to discuss basic information regarding the COL application review process and potential environmental impacts of the proposed plant. Comments received via e-mail, letter, or fax receive the same consideration as comments received in person at the public meetings. Appendix D contains information regarding the two scoping meetings and in-scope comments received during those scoping periods; this appendix contains all comments received on the draft EIS. These are procedural comments and no change to the EIS was made as a result.

Comment: For the above-stated reasons [related to the operational and cumulative surface water impacts], the DEIS is inadequate, does not comply with NEPA, and cannot serve as the basis for the issuance of the proposed combined licenses. (**0128-6** [Mayfield, Julie])

Response: *The review team disagreed with this comment. In Chapter 2 of the EIS, existing conditions at the Lee Nuclear Station site are described. Water use for Lee Nuclear Station and impacts to surface water are discussed in Chapter 5. Cumulative impacts to surface water are discussed in Chapter 7. No change was made to the EIS as a result of this comment.*

E.2.3 Comments Concerning Site Layout and Design

Comment: As design changes are submitted to the NRC for updating the Final Safety Analysis Report (FSAR), Duke Energy also plans to provide the NRC supplemental updates to the Environmental Report (ER) to reflect conforming changes. These supplemental updates will be provided during March 2012 and April 2012.
(**0134-2** [Fallon, Chris])

Response: *Duke provided additional information regarding proposed design changes to the NRC in letters dated March 29, 2012 and April 30, 2012 (Duke 2012a-d). Chapter 3 of the EIS (Site Layout and Plant Design) was revised to incorporate the proposed design changes.*

Comment: Figure 3-1, Page 3-2; Section 3-1, Page 3-3; Figure 3-2, Page 3-4: Cooling Tower arrangement has been updated (three towers to two towers per unit, removal of the 20 ft earth berms, tower dimensions and general location in relation to the plant and associated plant facilities). Per Comment #3 above, Duke Energy plans to provide a supplemental response in March 2012 to reflect these changes.
(**0134-12** [Fallon, Chris])

Response: *EIS Figures 3-1, 3-2, and 3-4 were updated to show the revised cooling tower number, arrangement, dimensions, and associated layout changes.*

Comment: Section 3.2.2, Page 3-5, Line 33: Make Up Ponds A and B and Hold-Up Pond A are classified as waters of the US. Appropriately permitted temporary and/or permanent holding ponds will be designed, constructed and operated as needed before release of storm water into any of the listed ponds.
(**0134-13** [Fallon, Chris])

Response: **With respect to documenting the site layout and design,** *sections 3.2.2.1, 3.3.1.1, and 3.4.4.1 of the EIS were revised to reflect that temporary or permanent holding ponds would be designed, constructed, and operated as needed to manage stormwater, and that discharges to waters of the United States would be appropriately permitted.*

Comment: Section 3.2.2.2, Pages 3-8 through 3-21: Recent engineering and general layout updates are reflected in the noted permit applications submitted as outlined in Comments #1 and #2 above. Examples of updated information found in these applications:

- Intake structures - structure size including pump bays, fish protection screen calculations and screen size

- Blowdown and wastewater discharge - change in discharge diffuser elevation at Ninety-Nine Islands Dam and dredging details

(**0134-14** [Fallon, Chris])

Response: *Section 3.2.2, Cooling System (description) was revised to incorporate the proposed design changes, using various permit applications and supplemental environmental report (ER) information provided by Duke.*

Comment: Section 3.2.2.4, Page 3-23, Line 14: Duke intends to operate the concrete batch plant through initial operation of Unit 1 to support completion of construction of Unit 2. (**0134-15** [Fallon, Chris])

Response: *Sections 3.2.2.4 of the EIS was revised to describe the timing of concrete batch plant operation.*

Comment: Section 3.2.2.4, Page 3-24: Concrete Batch Plant: The concrete batch plant has been relocated to facilitate material handling and improve overall accessibility. Per Comment #3 above, Duke Energy plans to provide a supplemental response in March 2012 to reflect this change. (**0134-16** [Fallon, Chris])

Response: *Figure 3-4 of the EIS was revised to reflect the relocation of the concrete batch plant; no revision to Section 3.2.2.4 was necessary.*

Comment: Section 3.2.3, Page 3-24, Lines 24-25: The containment building is the tallest structure on site but is actually 229' 5" above grade. (Reference DCD Figure 3.7.2-12, sheet 8 of 12). Per Comment #3 above, Duke Energy plans to provide a supplemental response in April 2012 to provide an update to the view shed analysis. (**0134-17** [Fallon, Chris])

Response: *Section 3.2.3 and Table 3-10 of the EIS were revised to appropriately state the tallest structure height.*

Comment: Section 3.2.3, Page 3-25, Line 28: High Density Polyethylene (HDPE) pipelines, rather than concrete pipelines, are planned to convey raw water from the Broad River to various plant structures and to convey wastewater from the various plant water systems to the discharge structure. (**0134-18** [Fallon, Chris])

Response: *Section 3.2.3 of the EIS was revised to indicate that high-density polyethylene pipelines would be used to convey raw water and wastewater.*

Comment: Section 3.3.1.14, Page 3-32, Line 21: Many of the parking areas will be paved; however, some parking areas will be gravel. The graveled parking areas will be graded, drained appropriately and surfaced with compacted stone. (**0134-19** [Fallon, Chris])

Response: *Section 3.3.1 of the EIS was revised to add that some parking areas would be graveled.*

Comment: Section 3.4.2.1, Pages 3-36 to 3-38: Water balance details and the Make-Up Pond A intake pump arrangement have been updated. Per Comment #3 above, Duke Energy plans to provide a supplemental response in April 2012 to reflect these changes. (**0134-20** [Fallon, Chris])

Response: *Sections 3.2.2.2 and 3.4.2.1 of the EIS were revised to incorporate changes to the Make-Up Pond A intake pump arrangement.*

Comment: Section 3.4.4.1, Page 3-47, Line 4: Details for liquid waste management have been updated. Per Comment #3 above, Duke Energy plans to provide a supplemental response in March 2012 to reflect these changes. (**0134-21** [Fallon, Chris])

Response: *Section 3.4.4.1 of the EIS was revised to incorporate updates to liquid nonradioactive waste management.*

Comment: Section 3.4.4.1, Page 3-47, Line 10: Hold-Up Pond A should be included as a recipient of storm water runoff.
(**0134-22** [Fallon, Chris])

Response: *Section 3.4.4.1 of the EIS was revised to add Hold-Up Pond A as a recipient of stormwater runoff.*

E.2.4 Comments Concerning Land Use

Comment: Section 2.2.3.1, Page 2-11, Line 21: For clarification, the NRC should insert "a portion of" following "Broad River," or alternatively delete reference to state scenic waterway. The entire Broad River is not a state scenic waterway. The portion from Ninety-Nine Islands Dam to the confluence of the Pacolet River is considered a state scenic waterway. (**0134-5** [Fallon, Chris])

Response: *Section 2.2.3.1 of the EIS was updated to clarify that only a portion of the Broad River is a state scenic waterway.*

Comment: Section 4.1.2, Page 4-6, Line 15: Change "London Crossing" to "London Creek". (**0134-25** [Fallon, Chris])

Response: *The subject paragraph was deleted as part of the process of updating the text in Section 4.1.2. There is no use of "London Crossing" anywhere in the section.*

Comment: Section 5.1.1, Page 5-2, Line 38: Change "Sections 4.5 and 5.5" to "Sections 5.4 and 5.5." (**0134-49** [Fallon, Chris])

Response: *The correct section is 5.4, and Section 5.1.1 has been revised to reflect this.*

Comment: Section 5.1.2, Page 5-3, Line 18: Change Section 4.1.2 to 4.1.3. Transmission Line Corridors are discussed in 4.1.3. (**0134-50** [Fallon, Chris])

Response: *Section 5.1.2 was updated to reflect the correct section number.*

Comment: Section 4.1.2, Page 4-5, Line 32: The DEIS indicates that approximately 86 privately owned housing units will be demolished or removed from the Make-Up Pond C site. This work has already occurred.
(**0134-24** [Fallon, Chris])

Response: *The EIS was updated to reflect that all 86 residences have since been demolished or removed.*

Comment: Section 9.3.5.1, Page 9-159, Table 9-15: The table identifies the area of the Ancillary facilities as 450 ac. The Duke Energy response to RAI 127 and 131 provides the area of the ancillary facilities as 560 ac. (**0134-79** [Fallon, Chris])

Response: *Section 9.3.5.1 was changed to reflect 560 ac of ancillary facilities, as shown in Duke's response to the NRC staff's request for additional information (RAI) 127 (Duke 2010a).*

Comment: Section 9.3.5.1, Page 9-160, Lines 1-3: The DEIS states: "As described above, building the proposed facilities, new transmission-line corridors, inundation for a supplemental water reservoir, and building the water intake and railroad spur to support the new units have the potential to affect as much as 4600 ac of land." When using the correct area for the ancillary facilities contained in the Duke Energy response to RAI 127 and 131 (560 ac), the total area is 4710 ac. (**0134-80** [Fallon, Chris])

Response: *Section 9.3.5.1 has been updated to reflect the change from 4600 ac to 4710 ac.*

Comment: Lake Cherokee Construction of Make-Up Pond C would directly impact approximately 4.4 acres of land titled to DNR at Lake Cherokee. Make-Up Pond C would inundate forest land on the DNR site and directly affect the Lake Cherokee Dam. Lake Cherokee is public property titled to the State of South Carolina through its agency, DNR. Lake Cherokee provides recreational fishing opportunities to the public constituting the highest and best use of the property. DNR likely would oppose any attempt by Duke Energy to acquire Lake Cherokee and alter the use of these lands by way of condemnation. DNR can consider making some part of its land at Lake Cherokee available for use and/or modification. The DNR Board has adopted a policy for responding to requests for exclusive use of DNR owned land. A copy of DNR Board Policy 400.01 is attached. In the event DNR staff and Duke Energy reach an agreement on use of DNR land, the agreement would have to be approved by the DNR Board and the South Carolina Budget and Control Board. Sections 1-11-65, 10-1-130, and 10-1-135, SC Code Ann, govern this issue.

Based upon DNR Policy 400.01, the statutes cited above, and past action on requests to use DNR owned land, DNR is willing to negotiate an agreement to allow Duke Energy to use and/or modify some part of the Lake Cherokee tract. Among the considerations in any negotiation will be the following:

1. DNR must be fully compensated for the loss of use of any land,

2. The physical integrity of Lake Cherokee and its supporting infrastructure must not be compromised,

3. The future use of Lake Cherokee as a public recreational site must not be adversely effected, and

4. The most likely means of authorizing use of DNR land would be by way of a grant of an easement.
(**0126-20** [Vejdani, Vivianne])

Response: *This comment is directed to Duke, and the NRC does not have the authority to require such considerations. Land-use impacts from building and operating the proposed Lee Nuclear Station are discussed in Sections 4.1 and 5.1 and recreational impacts are discussed in Sections 4.4 and 5.4. No changes were made to the EIS as a result of this comment.*

Comment: Before U.S. -- before the Lee plant's even built, we're going to displace 86 people from their homes, flood 620 acres, remove wildlife habitats and trees. The entire site actually engulfs when you add it up 1900 acres on the west side of the Broad River. I call this a disruptive invasion and disregard for natural habitat. (**0013-7-3** [Sorensen, Laura])

Response: *This comment expresses concern regarding the land-use conversion of parts of the Lee Nuclear Station site and the Make-Up Pond C site. Land-use impacts from building and operating Lee Nuclear Station are discussed in Sections 4.1 and 5.1, and ecological impacts are discussed in Sections 4.3 and 5.3. Housing impacts, including the 86 housing structures already demolished or removed on the Make-Up Pond C site, are discussed in Section 4.4. No changes to the EIS were made as a result of this comment.*

Comment: The DEIS indicates the Licensee is uncertain regarding other uses of the Make-Up Pond C site. DNR appreciates the sensitive nature of operation and protection of a nuclear generation station. However, London Creek constitutes Waters of the United States and any impacts to it for purposes of a reservoir the size of the one being proposed should include an examination of compatible public use opportunities. These compatible public use opportunities might include fishing and boating opportunities and other compatible appreciative uses along the northern boundary. DNR recommends continued discussion with the Licensee regarding potential, compatible public use opportunities on a portion of the proposed Make Up Pond C.
(**0126-2** [Vejdani, Vivianne])

Comment: 5.1.1 The Site and Vicinity
See comments in section 2.2.2. The Make-Up Pond C Site. (**0126-24** [Vejdani, Vivianne])

Response: *The NRC regulates the nuclear industry to protect public health and safety under the Atomic Energy Act of 1954 and the Energy Reorganization Act of 1974, and does not have the authority to require the public-use conditions recommended in the above comment. Land-use impacts, including those on the Make-Up Pond C site, from building and operating Lee Nuclear Station are discussed in Sections 4.1 and 5.1 of the EIS. No changes were made to the EIS as a result of these comments.*

Comment: Section 4.1.2, Page 4-5, Line 27: The basis for the 309 acres listed could not be located in the references Duke 2010c and 2010n.
(**0134-23** [Fallon, Chris])

Response: *All of the land use acreage data in Section 4.1.2 has been updated to reflect the latest proposed project design data submitted to the NRC by the Applicant.*

Comment: Table 10-1, Page 10-5: The Table states: "Permanent use of approximately 149 ac. on the site, as much as 1900 ac for Make-Up Pond C ..." Environmental Report Table 10.1-1 indicates 1100 ac. would be used for Pond C. The DEIS Section 4.1.2 indicates 1470 ac. would be used for Pond C. Duke cannot determine the source of the 1900 ac statement. A reference or explanation of the acreage number would be helpful as it differs from both the ER and other DEIS sections. (**0134-86** [Fallon, Chris])

Response: *All of the land use acreage data in Section 10.6 has been updated to reflect the latest proposed project design data submitted to the NRC by the Applicant.*

E.2.5 Comments Concerning Surface Water Hydrology

Comment: The impact of the nuclear plant will have on the water sources in terms of use and waste is not justifiable. (**0001-3** [Stoll, Irene])

Comment: [We're opposed to the construction of all new nuclear reactors for many reasons:] massive water use... (**0012-7-2** [Hicks, Katie])

Comment: Whereas Duke's nukes will require massive water withdrawals, water loss through evaporation, and degradation of the small, drought-prone Broad River. (**0013-11-5** [Smith, Coleman])

Comment: In conclusion let me state that nuclear power is expensive and dangerous. In this case it is also too much of a burden on the Broad River, which already is under stress. (**0013-13-3** [Bliss, Rachel])

Comment: My position [opposition] is based on... The dependence of this project on the Broad River which we cannot expect to support this Project for the long term, based on past drought circumstance in this area. (**0047-2** [Lauden, Loy])

Comment: There are many other decisive reasons to stop the proposed plant, including the excessive water usage, the thermal pollution of the Broad River... (**0083-7** [Broadhead, Susan])

Comment: [Other Nuclear factors of concern:] Water use and contamination - huge cooling demand [on the Broad River] from existing sources. (**0093-7** [Howarth, Robert F.])

Comment: There are many other decisive reasons to stop the proposed plant, including the excessive water usage... (**0098-5** [Broadhead, Susan])

Comment: [There are many other decisive reasons to stop this plant, including] ...the thermal pollution of the Broad River... (**0098-6** [Broadhead, Susan])

Response: *These comments express opposition to licensing Lee Nuclear Station Units 1 and 2 because of perceived impacts on water resources, especially the Broad River. Section 5.2 of the EIS discusses the impacts on water resources from operation of the proposed Lee Nuclear Station Units 1 and 2. No changes to the EIS were made as a result of these comments.*

Comment: Building the W.S. Lee Nuclear Plant will: Stress the Broad River & it's habitat by using 47 million gallons of water a day and returning "thermal pollution" back into the river. (**0004-3** [Cunningham, Kristine])

Comment: [Building the W.S. Lee Nuclear Plant will:] ...compromise the Broad River, Catawba River, Pacolet River, the French Broad River, and Lake Lure. (**0004-7** [Cunningham, Kristine])

Comment: The flow of the river has already been greatly stressed due to permits already given to many industries and municipalities along its journey from the mountains to the sea. The oxygen content of the water is already greatly reduced and will be further degraded by the emission of hot or warm water by this facility. The Broad River, as its name suggests, is a broad but not a deep river. In times of drought, which we have had in recent years, and low rainfall, as we continue to endure with no end in sight, you can often see rocks from the river bottom protruding above the water level. Anyone could probably walk across the river from rock to rock in the dry summer months. York County has been for years in a heated and expensive battle with North Carolina over water rights to the Catawba River on the eastern boundary of York County. It is only a matter of time that we will have to go to the Broad on the western boundary of our county as a water supply. If there is no water or if the water is severely degraded, where will our water supply come from? There is a hydroelectric plant in Lockhart just south of the proposed site. This plant will be impacted by the loss of water supply to their generators. (**0012-10-1** [Connolly, Mary Ellen])

Comment: The proposed reactor's water withdrawals and degradation of the Broad River are another concern that would place further strain on an already strained river basin. In addition to the roughly 47 million gallons of water per day the plant would withdraw, we've calculated that the Broad would lose roughly 5-1/2 billion gallons of water each year due to forced evaporation of heated water downstream of the plant. (**0012-7-10** [Hicks, Katie])

Comment: ...and massive withdrawals and toxic discharges are also a potential threat to drinking water supplies downstream. The draft EIS indicates that the City of Union's drinking water intake is just 21 miles downstream of the proposed discharge. (**0012-7-12** [Hicks, Katie])

Comment: Use of the Broad River to cool this reactor does great environment harm to a wide region in SC and NC. (**0019-4** [Doebber, Tom], **0020-4** [Klein, Art and Michelle], **0026-3** [Doebber, Ian] [Doebber, Rachel])

Comment: Precious water resources are needed in order to cool nuclear reactors. (**0022-3** [Sloss, Barbara])

Comment: Nuclear power plants have adverse effect on public water resources. (**0024-4** [Whitefield, Anne])

Comment: To use 47 millions gallons of water a day to produce energy at a time when our water resources are dwindling does not seem wise. (**0039-3** [Whiteside, Cassie], **0043-3** [Reeser, Rachel])

Comment: How can one legitimize using over 40 million gallons of water per day to operate such a plant; all it takes is a significant drought to make such usage most problematical indeed. (**0046-2** [Southworth, Win])

Comment: Lee Nuclear Plant would use 47 million gallons of water per day with 75% loss through evaporation. The NRC has called the Broad River "small" and climate change in the region has been causing droughts for the last decade or more. Shut down could happen due to lack of water for cooling, a very dangerous occurrence. The Broad River currently supports a hydropower station, the Cliffside coal plant only 16 miles up river and Summer nuclear plant (1 reactor, 2 more proposed) downstream near Columbia, SC. (**0048-4** [Skeele, Michele and Skip])

Comment: Nuclear power plants use gargantuan amounts of water to cool the reactors. Fresh, clean water is a basic human right and is better reserved and protected for people to drink, cook, and bathe; not for unsafe, expensive, finite energy production. (**0059-3** [Raleigh, Carolyn])

Comment: Water problem: The plant would use 47 million gallons of water a day with 75% loss through evaporation. Eventually the river would become overused and drought could occur. (**0082-2** [Karpen, Leah R.])

Comment: The Broad River is not strong enough to support this station, especially in view of coming drought. (**0085-3** [Allison, Patricia])

Comment: As an avid gardener, I am acutely aware of water. We have frequently had droughts in recent years and another is projected for this area in 2012. Does it make sense to build a nuclear plant here that will need large amounts of water for cooling? Droughts occur most frequently in the summer, when most electricity is used. Nuclear plants in the South had to close down in 2011 because they could not be cooled. (**0097-2** [Larson, Jean])

Comment: ...in this case it [nuclear power] is also too much of a burden on the Broad River which already is under stress. (**0104-5** [Bliss, Rachel])

Comment: Building the W.S. Lee Nuclear Plant will: 1. Stress the Broad River & it's habitat by using 47 million gallons of water a day and returning "thermal pollution" back into the river. (**0112-4** [Andrews, Josephine] [Anonymous] [Beattie, Kathryn E.] [Boever, Virginia] [Boyle, Ella] [Brogan Prindle, Cathleen] [Davis, John] [Flores, S.] [Hamahan, Clare] [Keil, A. Eugene] [Leverette, Will] [Peterson, Harry] [Peterson, Martha J.] [Rittenberg, David] [Rustin, K.])

Comment: [Building the W.S. Lee Nuclear Plant will:] compromise the Broad River, Catawba River, Pacolet River, the French Broad River, and Lake Lure. (**0112-7** [Andrews, Josephine] [Anonymous] [Beattie, Kathryn E.] [Boever, Virginia] [Boyle, Ella] [Brogan Prindle, Cathleen] [Davis, John] [Flores, S.] [Hamahan, Clare] [Keil, A. Eugene] [Leverette, Will] [Peterson, Harry] [Peterson, Martha J.] [Rittenberg, David] [Rustin, K.])

Comment: [If Lee Nuclear Station is built:] Local Agriculture would suffer. (**0114-6** [Lovinsohn, Ruth])

Comment: During droughts, the shallow Broad River may not have enough water to both serve the nuclear power plant and the community that relies on this water both upstream and downstream.
(**0119-27** [Thomas, Ruth])

Comment: Water will be needed for cooling and the most likely source would be western North Carolina. We already have limited sources for water and a political battle over maintaining it. (**0122-5** [Justice, Cynthia and Michael])

Comment: The water usage issue alone should prevent construction. (**0124-2** [Hayes, MD, J. David])

Comment: 47 million gallons of water per day is estimated to be taken from the Broad River to operate the plants. This is a time when all governments in all nations are beginning to recognize water as a scarce resource. Returning less than 1/2 of the water to the Broad River in a warmed, possibly polluted state, is unacceptable. (**0132-6** [Cahill, Joanne])

Comment: The BROAD RIVER itself has been deemed INADEQUTE by the NRC to support the proposed LEE plant which would use 47 million gallons of water per day, with 75% loss through evaporation, causing possible droughts. Shut down could happen due to a lack of water for cooling; a horribly dangerous occurrence. Furthermore, the Broad already supports the Cliffside coal plant, a hydropower station, and Summer nuclear plant downstream in Columbia, SC. (**0133-3** [Christopher, Lucy D.])

Response: *The review team evaluated the impacts of building and operating the proposed Lee Nuclear Station Units 1 and 2 on local and regional water resources. Impacts related to construction are presented in Section 4.2; impacts related to operation are presented in Section 5.2. The cumulative impacts of Lee Nuclear Station Units 1 and 2 construction and operation, in the context of other past, present, and reasonably foreseeable future demands on Broad River water resources (including coal and other nuclear plants), are presented in Section 7.2. Ecological impacts are presented in Sections 4.3, 5.3, and 7.3. The review team's assessment of plant water use (withdrawal and consumptive use) considered both current and future conditions, including changes in water demands to serve the needs of future population, and changes in the water supply. Lee Nuclear Station Units 1 and 2 would use closed-cycle cooling, which substantially reduces the amount of water withdrawn from the source waterbody. Duke does not plan to consumptively use water from the Broad River when river flow is below 483 cfs, but would withdraw water from one of its supplemental reservoirs instead. Duke's proposed water-withdrawal plan is described in Section 3.4 of the EIS; ultimately, withdrawals from the Broad River would be regulated by a withdrawal permit issued by the SCDHEC and the flow requirements imposed by the Federal Energy Regulatory Commission (FERC) on the Ninety-Nine Islands Hydroelectric Project (FERC 2011). The review team's impact assessment also considered impacts on water quality; liquid discharges to the Broad River would be limited by NPDES Permit No. SC 0049140 issued by the SCDHEC on July 17, 2013, to Duke for the Lee Nuclear Station (SCDHEC 2013). No changes were made to the EIS as a result of these comments.*

Comment: The Lee Nuclear Site Thermal and Chemical Plume: The plume, mixing zone, boundaries and magnitude were established by Duke's consultant based on 18 cfs discharge. The plume, boundaries and magnitude should be established during the maximum discharges of 64 cfs to minimize the adversely impact on fish community. The frequency of such high discharge should be calculated as well. SCWF recommends more biological and chemical monitoring both before start-up and after commencement of operations so appropriate changes can be instituted. (**0135-6** [Gregg, Ben])

Response: *Duke states that the maximum discharge rate of 64 cfs would occur when water is cycled through the cooling towers fewer times to manage high total solids in the source water. High total solids would typically occur with flood flows in the Broad River, and would not be expected in water from the makeup ponds used when river flow is low. Duke expects atypical (much higher or lower than 18 cfs) discharge rates to occur less than 5 percent of the time (Duke 2011a). Constituent discharge limits, mixing zone limits, and monitoring and reporting* *requirements were established by the SCDHEC in NPDES Permit No. SC0049140, issued on July 17, 2013, to Duke for the Lee Nuclear Station (SCDHEC 2013). The EPA and the State of South Carolina have the authority to require nonradiological monitoring in the waters of the United States; the NRC's authority to impose monitoring requirements in waters of the United States is limited to radiological monitoring. No changes were made to the EIS as a result of this comment.*

Comment: 5.2.3.1 Surface-Water Quality
Solutes from the Broad River, such as heavy metals, and chemical contaminants will be concentrated as they pass through the closed cycle cooling system before their eventual discharge into the Ninety-Nine Islands Reservoir. The Review Team concluded: the concentrations of the solutes would be diluted by the streamflow within a short distance below the dam, and any localized increase would be undetectable relative to background by the time the water reaches the City of Union, South Carolina public water supply intake 21 mi downstream of the discharge.

DNR notes that South Carolina R. 61-68, Water Classifications and Standards allows for the establishment of a mixing zone, under certain circumstances, where chemical and thermal effluent "mixes" with surface water and becomes assimilated, and where water quality criteria can be exceeded (the Licensee has requested such a mixing zone in their NPDES permit application.) R. 61-68(c)(10) stipulates that the size of the mixing zone shall be minimized. DHEC typically interprets this such that the dimensions of the mixing zone, for chronic toxicity, shall be no more than 2 times the width of the river in length and 1/2 the width of the river in width, and for acute toxicity, no more than 1/3 the width of the river in length and 1/10 the width of the river in width. DNR has requested consultation with DHEC throughout the NPDES permitting process regarding appropriate biological and chemical compliance monitoring. DNR requests courtesy notification of water quality excursions, should they occur. (**0126-26** [Vejdani, Vivianne])

Comment: In addition, we are concerned with the levels of copper and zinc proposed in the liquid effluent that exceed the SCDHEC criterion maximum concentration for these metals, and violate South Carolina Water Classifications and Standards Regulation 61-68, established maximum concentrations for freshwater. (**0141-6** [Caldwell, Mark] [Stanley, Joyce A.])

Response: *These comments concern water-quality impacts of liquid effluent discharges to the Broad River. Duke must obtain an NPDES permit from the SCDHEC prior to discharging liquid effluent to a surface waterbody. As noted by the South Carolina Department of Natural Resources (SCNDR) on page 10 of its draft EIS comment letter to the NRC dated March 6, 2012 (SCDNR 2012a), Duke's NPDES permit application requests a mixing zone that is minimized per Regulation 61-68(c)(10) (Duke 2011a, 2011b). The mixing zone limits, along with constituent discharge limits monitoring requirements, and reporting requirements were* *established by the SCDHEC in NPDES Permit No. SC 0049140, issued on July 17, 2013, to Duke for the Lee Nuclear Station (SCDHEC 2013). No changes were made to the EIS as a result of these comments.*

Comment: *Water Quality*

The DEIS concludes that the impacts on surface-water quality from construction and preconstruction of the proposed Lee Nuclear Station Units 1 and 2 would be small (page 4-16).

Recommendations: We recommend that the FEIS identify the specific measures to ensure that construction contractors follow their construction standard specification and special provisions. The FEIS should clarify the effects of the project on stormwater volumes related to the amount of impervious surfaces to be constructed. Alternative minimization strategies such as pervious concrete or porous pavement should be considered to help offset impacts, in areas where those approaches are feasible and can meet safety requirements. Alternative paving materials have additional environmental benefits besides groundwater recharge, including reduced stormwater runoff and reduced pollution. (**0142-17** [Mueller, Heinz])

Response: *The measures and controls to limit adverse impacts during construction and preconstruction are described in Section 4.11 of the EIS. These include erosion control and stormwater-management measures such as limiting ground disturbance, performing ground-disturbing activities in accordance with the SCDHEC stormwater permit requirements, using cofferdams and settling basins to protect waterbodies, and generally using best management practices (BMPs) to minimize erosion and sedimentation.* The South Carolina Storm Water Management BMP Field Manual *(SCDHEC 2005) includes a section on the use of porous surfacing. No changes were made to the EIS as a result of this comment.*

Comment: ...and if it [the Broad River] gets hot enough, the water can't be used for cooling anymore. Several years ago when there was a real heat wave in Europe, they had to close down some of their nuclear power plants because the water wasn't cool enough to cool the reactors. (**0012-15-4** [Larsen Clark, Brita])

Comment: Lee nuclear plant would use 47 million gallons of water per day with 75 percent loss through evaporation. Two large cooling lakes with steam and cool two reactors that would produce as much heat as 1,200 atomic bombs. Is this rational in the age of climate change? If the area experiences a drought where will the water come from to cool the reactors? (**0013-20-2** [Craig, Anne])

Comment: but certainly in the event of a catastrophic accident [there seems to be a very inadequate water supply] to deal with handling the situation that might result if there were a serious problem with the plant. (**0013-5-5** [Cremer, Claudine])

Comment: The Broad River is too small to accommodate the amount of water needed to run the plant safely. With all the recent drought problems in the Southeast, it is not using commonsense to add a new plant that will require continuous, massive use of water. (**0030-2** [Swing, Carol])

Comment: The following problems are among those we have identified: 1) The problem of continuously needing excessive amounts of water to cool the nuclear reactors' extremely high temperatures, to avoid a partial or complete meltdown, or explosions, or release of highly radioactive gases, particulates, and liquids. (**0119-26** [Thomas, Ruth])

Comment: People in this region will be adversely impacted if a facility is built that is vulnerable to reduced capacity and or increased chance of a major reactor accident due to heat impacts. (**0130-5** [Zeller, Lou])

Response: *These comments express concern that the water in the Broad River might not be available in sufficient quantity or at appropriate temperature to cool or safely shut down the reactors. The environmental review assesses the impacts of the operating units on local and regional water resources, as presented in Sections 4.2, 5.2, and 7.2 of the EIS. In addition, the impacts of heat lost to the air and water are discussed in Sections 5.3 and 5.7. The NRC's parallel safety review addresses the effects of the external environment on the operating units. The AP1000 design does not require a water source to safely shut down the units. Issues related to water temperature or supply with respect to safe plant operation or shutdown are presented in the Final Safety Evaluation Report (FSER). The environmental and safety review documents for Lee Nuclear Station Units 1 and 2 are available from the NRC at http://www.nrc.gov/reactors/new-reactors/col/lee/documents.html#nrcDocuments. No changes were made to the EIS as a result of these comments.*

Comment: ....she shared with me that the demand of this plant would require, I think she said, 47 million gallons a day. And I just got confirmation that you think it's about 50 million gallons a day. And I simply -- being that I'm trying to protect the water quality and quantity, I -- that number -- it just didn't mean anything to me. It's like, I don't know, is that a lot, is that not a lot, what do the people need, what are the -- what is the demand for the public in this entire Broad River watershed so that I can compare what demand this nuclear plant will require. And especially in light of global warming, whether you believe that or not, there's certainly, you know, climate changes and droughts in 2002, 2007, 2008. And they're getting longer. And we've had no snow. And, you know, so I think this is a very real pattern that we're seeing here. So I'm very concerned about supply and demand. And so, anyway, I decided -- I work with the DENR up in North Carolina, with Department of Water Resources and also the Department of Water Quality. And then I figure, Well, this is in South Carolina, and part of the Broad River watershed is down in South Carolina so I know DHEC manages all that, so maybe they would have some numbers for me. But I didn't get any luck with talking to the -- with the DHEC people to get some real numbers on what is the demand of the people in this watershed, in this Broad River basin, except from North Carolina. I talked to Steve Reed, a section manager for the Broad River basin of the Division of Water Resources in North Carolina. And he gave me -- he had to hustle to get some statistics. And he came up with this, he and his team. He said that -- and just keep that 50 million gallons a day in your head to compare it to so we can compare apples to apples in using that unit of measurement, millions of gallons a day demand -- he said that in just the water supply system's use, which is all the water piped -- okay -- on all the water systems just through pipes through the Broad River basin and all of North Carolina and including Gaffney, South Carolina was -- the requirement was 51 million gallons a day that was used by human beings from piped in systems -- water systems. That amount -- if you're saying, Well, is that the total use of the entire basin, no, you've got people on wells and you have ground water. So we're not even including that. I'm just simply telling you that the water in the pipes that are being supplied to this basin, 51 million gallons are used, which is exactly what this plant will probably need. (**0012-4-4** [Conard, Sky])

Comment: The Broad River additionally also supports currently a hydro power station, the huge Cliffside coal plant 16 miles upriver, and the Summer nuclear plant. (**0013-20-4, 0095-5** [Craig, Anne])

Comment: It [the Broad River] currently supports a hydropower station, the huge Cliffside coal plant only 16 miles upriver and Summer nuclear (1 reactor, 2 more proposed) downstream near Columbia, SC (**0017-5** [Morgan, Tom and Barbara])

Response: *The review team's evaluation of the cumulative impact of past, current, and planned consumptive use of water in the Broad River basin is discussed in Section 7.2 of the EIS, which considers other existing and proposed facilities in the region. No changes to the EIS were made as a result of these comments.*

Comment: And then I'm concerned about this so-called filling Pond C. It is a 638-acre lake that is 116 feet deep. It is a reservoir which is going to be created. They're going to dig a hole in the earth to fill it with water from the Broad River. I have no idea how many cubic square feet of water that is. I don't know what that would contain. But it would be -- this obviously translates to a huge, inordinate demand of water from the Broad River, water that is essential and sustains the region's people and all living things. (**0012-4-5** [Conard, Sky])

Comment: The draft EIS does not adequately show that Make-up Pond C's capacity will suffice to maintain plant operation and protect water quality and flow in all possible drought scenarios, so we believe its negative impacts outweigh its benefits. (**0012-7-4** [Hicks, Katie])

Comment: The question was brought up earlier about how long the water supply would last. I just did some simple back of the envelope calculations based on the draft EIS and they indicated that if withdrawals from Pond C are made necessary by drought that that pond's supply would last, more or less, about 90 days. Since climate science predicts that many parts of the world will experience longer and deeper droughts than ever in the coming years, Duke Energy's drought contingency plans are insufficient considering both the high level of uncertainty regarding the length of future droughts in the Broad River basin. (**0012-7-9** [Hicks, Katie])

Comment: We have had droughts that have shut down nuclear plants -- perhaps this year -- certainly in the past. And from listening to the testimony this evening it seems that the water issue is probably the greatest concern with these plants. There seems to be a very inadequate water supply to deal, not only with the daily operation... (**0013-5-4** [Cremer, Claudine])

Response: *Duke's water-withdrawal and management plan with respect to Broad River and makeup pond use is presented in Section 3.4.2 of the EIS. Water withdrawals from the Broad River, including water needed to fill Make-Up Pond C, would be regulated by the withdrawal permit issued by the SCDHEC and by the flow requirements imposed by the FERC on the Ninety-Nine Islands Hydroelectric Project. As proposed, Make-Up Ponds B and C could supply water for more than 120 days (4 months). A commenter correctly notes uncertainty associated with prediction of future droughts. The review team considered the design of Lee Nuclear Station Units 1 and 2 as a source of baseload power, the supplemental cooling water provided by Make-Up Pond C, and Duke's proposed water-withdrawal plan to be reasonable under most scenarios, including future regional growth and climate change during a 40-year operating period. There is a small chance that Lee Nuclear Station would have to cease electrical generation if cooling water supply was limited by a severe drought. However, based on the review team's analysis, it was determined that this would occur so infrequently that the project would still be appropriately considered as a source of baseload generation. In addition, based on the design of the AP1000, a water source is not required to safely shut down the units. No changes were made to the EIS as a result of these comments.*

Comment: I'm concerned about that Duke Energy would be poised to further drain our water resources by purchasing neighborhood established or future water supply systems such as the Broad River Water Authority, the Inman Campobello Water District and the proposed Polk County South Water Department where I'm in, the surface waters in my back yard, which are Lake Adger and its supplier, the Green River which drains then into the Broad River -- so this is all part of the same system. (**0012-4-3** [Conard, Sky])

Comment: [This flawed project would:] be poised to further drain our water resources by purchasing neighboring established or future water supply systems such as the Broad River Water Authority, the Inman-Campobello Water District, and the proposed Polk County South Water Department. (**0094-3** [Conard, Sky])

Comment: Our primary concerns are the potential impacts of the plant to the Broad River watershed. Although the proposed plant is downstream of North Carolina, the long-term commitment of significant water resources to this proposed downstream use necessarily reduces the opportunities for future upstream uses of that same water supply. This is of particular concern as Western North Carolina continues to grow as a region and will need additional water supplies to support its expanding population and growing economy and to maintain the ecological integrity of the Broad River basin in North Carolina. Indeed, the State of North Carolina has recently identified the need for a new public water supply source in the Green River watershed in Polk County, which was the catalyst for the creation of GRWA. Another concern is that if there prove to be insufficient local water supplies for the operation of the proposed plant going forward, Duke Energy might look to upstream water suppliers to secure additional water, thus limiting even more the public supply and opportunities for growth and development upstream of the plant and risking ecological harm to the Broad River watershed. In short, we believe that the Lee nuclear plant cannot be built and operated without causing unacceptable adverse impacts to the human environment. (**0128-1** [Mayfield, Julie])

Response: *The review team considered the impacts of Lee Nuclear Station Units 1 and 2, as proposed, on the local and regional water resources. The review team's evaluation of the cumulative impacts in Section 7.2 of the EIS considers other existing and proposed facilities in the region. However, Duke proposed to obtain water directly from the Broad River to operate Lee Nuclear Station Units 1 and 2; it did not propose to obtain water from other sources in the watershed. Therefore, the potential impact of purchasing water from other supply systems was not within the scope of the environmental review. No changes were made to the EIS as a result of these comments.*

Comment: The water consumption to be used, they promise to use something like 5 percent of the annual flow based off of the historic flow. And, unfortunately, with the effects of climate change, I don't know if we're ever going to see the historic flow again. I don't think it's safe to base our numbers off the rainfall we used to be seeing. (**0013-23-4** [Buscarino, John])

Comment: I also -- like someone else mentioned I have a concern about going back 85 years to look at the water flow and do your analysis based on 85 years rather than looking at more recent years. You've got more power plants on the river now; you've got more industry. There's more water draw, besides the fact that global warming is affecting evaporation and rainfall. (**0013-30-3** [McWherter, Lisa])

Comment: Broad River as water source: Lee Nuclear Plant would use 47 million gallons of water per day with 75% loss through evaporation. Two large cooling lakes, (one is a 3 day back-up) would steam and cool 2 reactors that produce as much heat as 1200 atomic bombs. Even the NRC calls the Broad River "small" and climate changes suggest possible droughts. (**0017-3** [Morgan, Tom and Barbara])

Comment: In these times of unprecedented climate change, we should also refrain from taxing the Broad River further, as well as all the people & life downstream. (**0084-4** [Lemoing, Melissa])

Comment: Our unstable climate is going to play havoc with the plants needs for water. (**0086-2** [Rylander, Kimchi])

Comment: Duke Energy's own environmental report includes a longitudinal analysis of flow-rates in the Broad River, which shows that there are potential problems with water supply:

During the 1998-2002 drought, operations would have been curtailed for 42 days during June-September 2002, which was the worst year of the drought. Part of this outage would have coincided with the summer peak power demand.

This reveals that based on historical data there are water supply uncertainties. The NRC fails to fully address the host of issues associated with the problem of rising temperatures. No mention is made of the potential for current and future climatological conditions to depart from the past. The agency was advised of this problem years ago by a knowledgeable critic:

"...when you're developing an ER upon which the EIS will be based...it would be good science, to be looking at the new projections for changes in coastline, increased storms, changes in water levels, changes in flood patterns. I don't see it happening and I think this Agency needs to get moving on forcing the licensees to confront these new realities."
(**0130-4** [Zeller, Lou])

Response: *In Section 7.2.1.1 of the EIS (cumulative surface-water-use impacts), the review team considered potential climate changes that could affect both water resources available for cooling and the impacts of Lee Nuclear Station Units 1 and 2 operations on water resources available to other users. This analysis concluded that with a decrease in streamflow of 10 percent over the license period, cumulative impacts would be moderate, but that the incremental impact associated with Lee Nuclear Station Units 1 and 2 would not be a significant contributor to the cumulative impact. No changes were made to the EIS as a result of these comments.*

Comment: Section 4.2.2.2, Page 4-13, Line 21: Discharging into a "collection tank" prior to ultimately discharging into Hold-Up Pond A has not yet been determined. Request that "collection tank" be deleted. The dewatering activity will be conducted after concurrence is obtained from SCDHEC. (**0134-26** [Fallon, Chris])

Comment: Section 5.2, Page 5-5, Line 7: Change the reference from (Duke 2008a) to (Duke 2011a).
(**0134-51** [Fallon, Chris])

Response: *The reference was updated in Section 5.2 of the EIS.*

Comment: Section 9.3.3.2, Page 9-57, Lines 21-23: The DEIS states: "Duke proposes that three cooling-water reservoirs with a total capacity of 34,000 ac-ft would provide supplemental water during very low flow conditions when adequate water from the river may not be available (Duke 2009b)." The Duke Energy response to RAI 127/131 (Duke 2010g) updated the reservoir size to 33,000 ac-ft.
(**0134-72** [Fallon, Chris])

Response: *Section 9.3.3.2 of the EIS was revised to include more recent information from Duke.*

Comment: 2.3.1.1. Surface Water Hydrology Impoundments

This section provides a discussion of the seasonal required minimum flows and drought contingency flow for the Ninety-Nine Islands Hydroelectric Project (Ninety-Nine Islands Project). The Review Team indicates that they are awaiting clarification from the FERC whether each of the seasonal minimum flows or only the drought contingency flow is the appropriate criteria to curtail withdrawals. For the Review Team's reference, Article 402 of the FERC license for the Ninety-Nine Islands Project, as amended on November 15, 20 11, is as follows:

> <u>Article 402</u>. Within 60 days from the date the Commission approves the gaging plan required in Article 403, except when *inflow* is less than the required minimum flow for a specific month, the licensee shall release from the Ninety-Nine Islands Project into the Broad River a *continuous* minimum flow of 966 cubic feet per second (cfs) (January through April), 725 cfs (May, June, and December), and 483 cfs (July through November) as measured below the project for the protection of fish resources below the project in the Broad River. During the December through June period, when *inflow* is less than the above required minimum flows, a *continuous* flow of 483 cfs shall be released as a drought contingency flow. If *inflow* is less than 483 cfs during any period, the licensee shall shut down all units when the pond elevation drops to the seasonal maximum drawdown limit required by Article 401 and shall operate one unit at its minimum hydraulic output for that portion of every hour which is necessary to discharge the approximate accumulated inflow. Alternatively, during low flow periods, the licensee may elect to open the trash gate or, otherwise spill water to release inflow. These minimum flow requirements may be temporarily modified if required by operational emergencies beyond the control of the licensee, and for short periods upon agreement between the licensee, the South Carolina Department of Natural Resources, and the U.S. Fish and Wildlife Service. If the flow is so modified, the licensee shall notify the Commission as soon as possible, but no later than 10 days after each such incident (emphasis added).

There should be no misunderstanding regarding the provision of seasonal minimum flows, triggers for releasing the lowest minimum flow and reservoir fluctuation limits for the Ninety-Nine Islands Project. Article 402 clearly states that the continuous seasonal minimum flow, or a drought contingency flow, when inflow is less than the seasonal minimum flow, are appropriate criteria for curtailment of withdrawals from the Broad River. DNR guards against any interpretation that reductions in releases down to or below 483 cfs could be based on reservoir levels rather than inflow. Reductions based on reservoir levels are not consistent with Article 402 of the FERC license, which stipulates that seasonal minimum releases and drought contingency releases are based on inflow. DNR will oppose any proposal to modify seasonal flows for the Ninety-Nine Islands Project. (**0126-3** [Vejdani, Vivianne])

Comment: Broad River minimum flow requirements: Article 402 of the FERC license for the Ninety-Nine Island Hydroelectric Project defines the seasonal minimum flow requirements as three tiers of seasonal flow. SCWF recommends the applicant use those tiers as a seasonal minimum flow during all times and not the lowest of the three tiers as suggested by the applicant. Withdrawals from Broad River to fill pond C should be curtailed like all other uses and withdrawals from Broad River during flows less than the seasonal minimum flows. Pond C should be refilled only during periods of higher than normal flows in Broad river. (**0135-1** [Gregg, Ben])

Response: *Withdrawals from the Broad River to operate Lee Nuclear Station Units 1 and 2 would be regulated by the withdrawal permit issued by the SCDHEC, and by the flow requirements imposed by the FERC on the Ninety-Nine Islands Hydroelectric Project. These comments express the opinion of wildlife resource management agencies that the seasonal minimum flow requirements of the present FERC license be retained as criteria for curtailing withdrawals (including pond refill withdrawals) from the Broad River, rather than the drought contingency minimum flow requirement. Such restrictions on withdrawals are within the purview of the SCDHEC pursuant to the South Carolina Surface Water Withdrawal, Permitting, and Reporting Regulation 61-119. No changes were made to the EIS as a result of these comments.*

Comment: Please incorporate the following comment. Page 3-35, line 14: Please add the following language: "Note that the operational conditions in Duke's water management plan are less stringent than requirements cited at 40 CFR Section 125.84(a) through (e) in EPA's Cooling Water Intake Structure rule for New Facilities. EPA's approval of an NPDES permit containing any conditions less stringent than those allowed in the rule at Section 125.84 is contingent upon a demonstration that the requested alternative requirements comply with 40 CFR Section 125.85." (**0080-1** [Shell, Karrie-Jo])

Comment: EPA's Proportional Flow Limitation

The Clean Water Act requires Duke to comply with either a withdrawal limitation of 5% of the mean annual flow or to propose an alternative requirement. Duke has proposed an alternative, but we do not believe there is adequate justification for varying from the Clean Water Act’s requirements. Duke’s calculations demonstrate that the presumed normal withdrawal of 78 cfs for 95% of the time would not exceed that 5% limitation when it is calculated using the required 10 year historical data (DEIS at 3-35-6). The DEIS does not address, however, how higher withdrawals from the Broad River, such as those used when the plant is at maximum use (134 cfs) or to refill the Make-Up Ponds, would also comply with this 5% flow rule. The DEIS says that these higher withdrawal amounts for refilling the ponds will not cause the river to run less than483 cfs, but it does not state whether or how these higher withdrawals would also comply with the 5% flow rule (DEIS at 3-36).

We also understand EPA will be making a determination of the appropriate flow history to be used as the basis for calculating the 5% (DEIS at 5-6). As weather patterns are changing rapidly and droughts have become more common, we support using the most conservative numbers in this calculation.
(**0128-2** [Mayfield, Julie])

Comment: *Recommendations*: In Section 3.4.2.1, Water Withdrawals and Transfers (page 3-35,line 14), please add the following language:

"Note that the operational conditions in Duke's water management plan are less stringent than requirements cited at 40 CFR Section 125.84(a) through (e) in EPA's Cooling Water Intake Structure rule for New Facilities. EPA's approval of an NPDES permit containing any conditions less stringent than those allowed in the rule at Section 125.84 is contingent upon a demonstration that the requested alternative requirements comply with 40 CFR Section 125.85."

(**0142-15** [Mueller, Heinz])

Comment: In addition, updated information regarding water management plans... should be included in the FEIS. (**0142-30** [Mueller, Heinz])

Response: *The purpose of the EIS is to disclose the impacts of the project as proposed; therefore, the EIS quotes Duke's proposed water-management plan (from its NPDES permit application [Duke 2011b]) and bases its impact assessment on that proposed plan. However, the recommended language supplied in the EPA's comment on the draft EIS was added to Section 3.4.2.1, immediately following Duke's proposed water-management plan. The review team notes that Duke's proposed water-management plan would result in far less impacts than the direct application of the requirements cited at 40 CFR Section 125.84(a) through (e) in EPA's Regulations Addressing Cooling Water Intake Structures for New Facilities (65 FR 65256) (limiting water withdrawals to 5 percent of the mean annual flow of the river). The EPA rule does not consider the normal seasonal variability of flows and therefore does not preclude water withdrawals within periods of extremely low flow. Duke is proposing an alternative requirement in which water withdrawals would typically be less than 5 percent of the mean annual flow, but which occasionally could exceed 5 percent during storage refill operations. Whenever Broad River flow is at or below 483 cfs, Duke would only withdraw non-*

consumptive cooling water from the river (about 1 percent of the mean annual flow); they would not withdraw water for consumptive use and they would not refill the makeup ponds. The EPA's approval of an NPDES permit containing alternative requirements as proposed by Duke as allowed in the rule at 40 CFR 125.84 is contingent upon a demonstration that the requested alternative requirements comply with 40 CFR 125.85. As indicated above, the EPA's recommended language was added in Section 3.4.2.1 of the EIS. On July 17, 2013, the SCDHEC issued NPDES Permit No. SC 0049140 to Duke for the Lee Nuclear Station (SCDHEC 2013) as authorized by the EPA.

Comment: The Review Team indicated that it is unclear whether a minimum release from Make-Up Pond C downstream from the dam will be instituted or required. The provision of a seasonally-adjusted minimum flow is DNR policy and is embraced by the South Carolina Surface Water Withdrawal, Permitting, Use, and Reporting Act (SC Code33 Ann. 49-4). DNR recommends that the Section 404 permit/Section 401 state water quality certification be conditioned to require a seasonal minimum flow release that is protective of downstream aquatic resources. The minimum flow should commence with the filling of Pond C to avoid and minimize adverse impacts to fish and the macrobenthic community downstream of the dam to the confluence of London Creek with the Broad River.
(**0126-23** [Vejdani, Vivianne])

Response: *This comment refers to permitting actions of agencies other than the NRC. The EIS is being completed in advance of several of these other permitting actions. If during subsequent permitting with the SCDHEC and the USACE, changes are identified that* could represent new and significant circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts or if the NRC staff determines that supplementation would further the purposes of NEPA*, the NRC would consider whether a supplement to the EIS would be appropriate. No changes were made to the EIS as a result of this comment.*

Comment: [The NRC fails to fully analyze the following potential impacts of elevated water temperatures in the Broad River and its water shed:]

* The evaluation of increasingly warmed water on tech specs for reactor cooling

* The evaluation of the impact of warmer ambient water temperatures on total withdrawal, consumption and evaporation

* The impact of warmed water on condenser cooling * nuclear power reactors around the world have gone to low-power or off-line due to elevated cooling water temperatures and the loss of efficiency in power production due to loss of effective condensation of steam used to generate power

* The impact on other facilities

* The need to provide cool water to the two William States Lee reactors could impact operations at other facilities up-stream from the facility, as well as the issue of whether heat generated at the Lee site would impact operations at facilities down-stream

* The impact of pollution in water at warmer temps on the ecology of the site and also down-stream

* Most chemical reactions are facilitated by elevated temperatures; a full analysis of the impact of reactor heat in hotter water on the other pollutants in the water from any source must be considered, including implications for the food chain

* The impact of reactors going off-line during heat wave on customers

* Specifically, the loss of power during a heat-wave should be factored in terms of impact on customers

* The impact of reactors going off-line on regional grid stability

* The potential for extended drought locally and in the region to exacerbate all of the issues identified above.
(**0130-12** [Zeller, Lou])

Response: *The proposed plant relies on closed-cycle cooling using cooling towers, and will not be noticeably affected by the source waterbody temperature because they rely on evaporation (latent heat exchange) over sensible heat exchange. Once-through-cooling systems are very sensitive to the temperature (sensible heat) of incoming water but cooling-tower systems are not. Therefore, there are no impacts caused by changes in source water temperature. The impacts on aquatic resources from operation of the proposed Units 1 and 2 are addressed in Section 5.3.2 of the EIS. No changes were made to the EIS based on this comment.*

Comment: And one of the things that was mentioned was related to water consumption -- water removal. And it's normally capped at 5 percent of the mean annual flow of the river. Yet, when the ponds -- when the Pond A -- or B or C are depleted then water is pulled from the river to refill the ponds at the same time that it's being pulled from the river for consumption by the power plant. And the problem is that those ponds are only going to be depleted in a drought year already. And then on top of that you're going to be refilling them past the time -- past the spring when there's spawning and breeding. You're going to refilling those ponds in July through February. July and August are already going to be the hard-hit months for that river anyway on a drought year. So you're going to be pulling more water above the normal 5 percent cap -- you're going to be pulling more water during months when the water level tends to be low -- July and August and September -- and that's going to be happening in a drought year. So I have a big concern about that. (**0013-30-2** [McWherter, Lisa])

Response: *This comment refers to an EPA rule limiting water withdrawals to 5 percent of the mean annual flow of the river. Duke's proposed water-withdrawal plan is presented in Section 3.4 of the EIS. Duke is proposing an alternative requirement in which water withdrawals would typically be less than 5 percent of the mean annual flow, but which occasionally could exceed 5 percent during pond refill operations. Water removal (withdrawal) from the Broad River for operation of the new units and for refilling the makeup ponds would be regulated by the withdrawal permit issued by the SCDHEC as well as by required minimum flows imposed by the FERC on the Ninety-Nine Islands Hydroelectric Project. Duke does propose to refill the makeup ponds in the July through February timeframe, but would do so within the minimum flow requirements of the FERC license and the SCDHEC withdrawal permit. Whenever Broad River flow is at or below 483 cfs, Duke would only withdraw non-consumptive cooling water from the river (about 1 percent of the mean annual flow) and would provide water for evaporative losses from the makeup ponds. They would not withdraw water for consumptive use and they would not refill the makeup ponds when Broad River flow is at or below 483 cfs. To minimize entrainment of aquatic organisms, Duke would not withdraw water to fill the makeup ponds in the March through June timeframe. No changes were made to the EIS as a result of this comment.*

Comment: Consumptive water loss associated with the operation of Units 1 and 2 has been estimated as a minimum of 54.8 cubic feet per second (cfs) and a maximum 64.8 cfs. The South Carolina Department of Health and Environmental Control (SCDHEC) use the 7Q10 flow to determine potential impacts of consumptive water use. The consumptive 7Q10 flow at the Project is 464 cfs. The evaporative use of the proposed units compared to the 7Q10 flow of 464 cfs is 7.2 percent. However, flows in the Broad River have historically been as low as approximately 220 cfs. If anticipated consumptive loss from Units 2 and 3 is subtracted from average daily flow during periods of flow as low as 220 cfs, the percent loss of Broad River flow increases to 28 percent. It is unclear what the instantaneous impacts to aquatic resources would be during low flow and drought periods from consumptive water loss.

In addition, evaporative losses would occur from each of the Make-Up Ponds. Duke estimates that during the month of July the evaporative loss from Make-Up Pond C would be 4.24 acre feet (ac-ft) per day. All ponds combined the evaporative losses during the month of July would be 5.71ac-ft per day or 177ac-ft for the entire month. (**0141-3** [Caldwell, Mark] [Stanley, Joyce A.])

Response: *In its water-management plan, Duke states that Lee Nuclear Station Units 1 and 2 would not consumptively use any water from the Broad River when Broad River flow is less than*

483 cfs, which is the minimum flow requirement of the Ninety-Nine Islands Hydroelectric Project FERC license. Duke's proposed water-management plan calls for using supplemental storage reservoirs to ensure a reliable supply of water for Units 1 and 2 while limiting adverse impacts to aquatic resources that could occur from consumptive use of the Broad River during periods of particularly low flow. The review team's assessment of water-use impacts during operation is presented in Section 5.2.2.1. The review team evaluated Duke's water budget calculations and performed an independent confirmatory water budget in its assessment. Both Duke and the review team included direct evaporative losses from cooling towers (55 cfs) and indirect evaporative losses from ponds (1.4 cfs in December to 5.7 cfs in July) in their water-use estimates. Neither Duke nor the review team took credit for the refill of the ponds that occurs via precipitation or condensation, which was a conservative approach. No changes were made to the EIS as a result of this comment.

Comment: I requested from Steve Reid, Section Manager for the Broad River Basin of the Division of Water Resources in North Carolina Department of Environmental Natural Resources (DENR) to provide some statistics for comparison. As of 2010, the total of just the water supply systems' use piped through the Broad River Basin in all of North Carolina and including Gaffney, South Carolina, was 51 million gallons a day. I have read that the Lee Nuclear Plant demands will equal or exceed this total in order to operate. Filling the "Pond C" (a 638 acre, 116 feet deep created reservoir) would require even more water. Obviously this translates to a huge, inordinate demand of water from the Broad River, which is NOT broad, water that is essential and sustains the region's people and all living things. The Clean Water Act of 1972 and the Constitution of every state says the people own the fisheries and waterways. Based on the Public Trust Doctrine*, everybody has the right to use the waterways, but nobody can use them in a way that diminishes their use and enjoyment by others. The proposed Lee Nuclear Plant will effectively diminish the public use and resource rights of the Broad River. Is this powerful entity, Duke Energy, actually privatizing our public asset of water? This is a violation of environmental laws. (**0094-1** [Conard, Sky])

Comment: When I testified at the public meeting in Gaffney on January 19, 2012, I offered figures for only North Carolina. Subsequently I obtained from SC Water Supply Planning Division, as well as from the NC Department of Environmental Natural Resources / Department of Water Resources, the current statistics of total public water system use in the Broad River Basin for the years 2010-2011, 178.3 million gallons per day. This does not include agricultural or industrial use. The reason I sought these figures was because no CURRENT figures were to be found in the Draft EIS. The EIS is required because the action of the proposal (building of the Lee plant), if implemented, will significantly affect the quality of the human environment. It is also needed to determine if the proposal is without unacceptable adverse impacts on the human environment. Also, consultation and coordination with federal, state, and local agencies are to be included as input to the preparation of this environmental review. GRWA questions, how can decisions regarding the impact level of the Lee plant's operation on the human environment be accurate, when it apparently does not even consider the public's current utilization of the water resources, nor consult appropriate state agencies for these numbers? I think there was unfair and inadequate public representation and consideration in this proposal, and therefore inaccurate assessments of impact levels in the EIS. How can the NRC / Duke Energy review team be sure that the impacts are "small" or "moderate" when they aren't considering the current human needs and utilization of the water to begin with? Therefore, I think the proposal to build the plant is contrary to the public's interest, and represents a conflict regarding resource use. (**0127-1** [Conard, Sky])

Comment: Current and Future Water Use

Section 2.3.2.1 of the DEIS purports to establish a baseline of current surface water uses in the Broad River Basin and concludes that the net consumptive use for the Broad River basin (withdrawal less return) for 2006 was estimated as 241 cfs DEIS at 2-31.Section 7.2.1.1 of the DEIS purports to estimate the increase in consumptive usage in the basin, saying the use across various sectors will increase to412.9 cfs by 2070. Nowhere in the DEIS, however, are these figures or the methodology or data used to reach them made clear. Without specific figures, assumptions, calculations, and methodology, it is not possible to determine how sound or reasonable these numbers are. If the NRC review team is going solely on these numbers in making its recommendation, the information behind these numbers must be included in the DEIS for full public review and comment.

(**0128-3** [Mayfield, Julie])

Comment: Impacts Analysis

As stated above, without sufficient information to determine if the current and projected consumptive uses in the Basin are correct, it is impossible to determine if the review team's assessment of the cumulative impacts of the plant on surface water in the basin are accurate. And although the review team does consider the effects of climate change on surface water flows, again, insufficient justification is included about these calculations to determine if they are reasonable or accurate. Therefore, the cumulative impacts assessment is inadequate and must be supplemented with additional information. (**0128-4** [Mayfield, Julie])

Comment: The DEIS also contains no information on the potential indirect impacts of the proposed plant's operation on surface water, and is, therefore, also inadequate. (**0128-5** [Mayfield, Julie])

Comment: Water

Since the purpose of the Draft EIS is to evaluate environmental issues and not financial data, let us regress to the topic of water. The NRC is in a unique position to conserve water, our most precious resource, by denying Duke Energy the chance to build this new nuclear station. Water is valued by the general public more highly than petroleum, electricity, or even food. Any design of power plant that so blatantly wastes our limited water resources is unacceptable. During the 40 year operating life of the William States Lee Nuclear Station, it would evaporate 600 Billion gallons of fresh water.

The proposed nuclear power plant may as well be fueled by clean drinking water - evaporating up to 43 million gallons per day, consuming more than 3/4 of a gallon for each kWh produced. Such consumption is irresponsible, environmentally unsound, and a threat to the health and well being of the downstream population. This is three times more fresh water than the entire populations of South Carolina (4.7 million) and North Carolina (9.65 million) combined will drink each day. If a 250kW Chevy V8 (335 horsepower) were fueled by water instead of gasoline, running wide open at 10 mpg, it would only consume 0.048 gallons per kWh, less than one tenth of what this proposed plant would burn. At the current cost of bottled water, the proposed 2.2 gigawatt facility would evaporate somewhere between 50 million dollars (sold in gallon jugs) and 400 million dollars (sold in small, fancy packages) worth of drinking water each day! (**0129-2** [Gamble, Dan])

Comment: Further, local residents would be affected if the Broad River and other water resources in the area are substantially reduced or compromised by the operation of Duke's WS Lee. NRC's EIS analysis is insufficient and therefore will not mitigate such impacts. (**0130-6** [Zeller, Lou])

Response: *The review team conducted its environmental review and prepared the EIS in accordance with the requirements of the NEPA and 10 CFR Parts 51 and 52. One of the primary functions of the EIS is to clearly articulate and disclose the tradeoffs between power and water. The proposed plant would create a new source of baseload electrical power generation. In the process of generating the electricity, water would be consumptively used and would no longer be available for any downstream use. A continuous supply of water is required while the plant is producing electrical power. Therefore, for this plant to satisfy a baseload power need, the water supply must be reliable. To ensure the plant has a reliable supply of water while eliminating adverse impacts that could occur from withdrawing water from the Broad River during periods of particularly low flow, Duke proposed using existing onsite storage capacity and adding an additional storage reservoir (Make-Up Pond C). By using water from these storage reservoirs, the timing of Broad River water withdrawals would occur outside periods of particularly low flow, and would thereby substantially mitigate impacts to downstream users. Initial filling of Make-Up Pond C would be completed prior to operation of Lee Nuclear Station Units 1 and 2. As noted previously, withdrawals from the Broad River would be regulated by a withdrawal permit issued by the SCDHEC and limited by the flow requirements imposed by the FERC on the Ninety-Nine Islands Hydroelectric Project. To put the proposed Units 1 and 2 evaporative losses in perspective, the 43 million gallons per day mentioned in the* *comment above is 3.6 percent of the 1200 million gallons per day (1858 cfs) mean annual flow of the Broad River below Ninety-Nine Islands Dam for the period 2000-2010. In its cumulative impacts assessment, the review team considered the changes in streamflow in the Broad River that are likely to occur over the life of the plant. Changes in flow are expected to result from changes in water use and climate change. Based on consultation with the SCDHEC, the review team was advised to rely on the analysis of water supply needs in the* Broad River Water Supply Study *(Duke Energy 2007). The review team's consideration of climate change impacts to streamflow relied on the U.S. Global Change Research Program's national assessment,* Global Climate Change Impacts in the United States *(GCRP 2009). The review team reported values based on a presumed 10 percent decline in annual flow over the license period of the station. The review team acknowledges substantial uncertainty in all climate forecasts and provides this assessment for context for the reader. No changes were made to the EIS as a result of these comments.*

Comment: Flood Impacts in London Creek: During major flood events in London Creek and Cherokee Lake, the peak flow will be significantly faster and higher in magnitude because of the lake water body in London Creek. The flood impact on Broad River may not be very significant because the size difference of the drainage area between London Creek and Broad River. However, the flood impact of London Creek will be very significant on property and personnel in the drainage area between Broad River and the proposed dam on London Creek. Flood zone volume should be considered in the design of London Creek dam to catch and store the flood volume and release it downstream in non-flood magnitudes. Releases from Ninety-Nine Island Hydroelectric Project should be synchronized with the flood from London Creek to minimize its impact on Broad River. (**0135-2** [Gregg, Ben])

Response: *Once built, Make-Up Pond C would represent a significant portion of the London Creek drainage. Any extreme precipitation event would be attenuated by the large area of the impoundment. The safety implications for flooding due to Make-Up Pond C would be considered in the NRC's separate safety review of the project and described in Section 2.4 of the FSER. No changes were made to the EIS based on this comment.*

Comment: Low Flow Operations DNR notes a discrepancy between the DEIS and the § 404 Application on the size of the thermocline needed for Make-Up Pond C. The DEIS indicates that the Licensee determined, based on examples from similar reservoirs in the region, that a thermocline of 20 ft would be needed as a zone of aquatic refuge. However, the § 404 Application indicates that there are "design constraints" to constructing the dam at the elevation needed to provide a 20-ft thermocline (653 ft msl). According to the § 404 Application, subsequent analysis showed that an upper volume of 17 ft would be sufficient to preserve the natural stratification and turnover pattern. DNR requests clarification on the size of the thermocline needed for aquatic refuge. (**0126-27** [Vejdani, Vivianne])

Response: *The review team reviewed Duke's calculations regarding the supplemental water needed and the size of Make-Up Pond C. The description of Make-Up Pond C size and drawdown in the EIS (Sections 3.2.2.2 and 3.4.2.1), and analysis of potential impacts on water and aquatic resources (Sections 5.2 and 5.3.2), are based on the proposed design with a Make-Up Pond C dam crest elevation of 650 ft MSL. Sections 3.2.2.2 and 5.3.2.1 of the EIS were revised to incorporate Duke's CWA 316(b) compliance demonstration, which showed that natural stratification would be maintained by preserving the upper 17 ft of the pond.*

E.2.6 Comments Concerning Groundwater Hydrology

Comment: Section 2.3.1.2, Page 2-26, Lines 16-17: DEIS States: "It is these wells that could affect or be affected by building and operating the proposed Lee Nuclear Station". Consider removing the sentence, as discussion of impacts belongs in Chapter 4 and 5. This statement could be misconstrued as indicating that these wells will be affected. (**0134-6** [Fallon, Chris])

Response: *This section of the EIS describes resources that "could affect or be affected" by building and operating the proposed Lee Nuclear Station, but does not describe potential impacts. No change was made to the EIS as a result of this comment.*

Comment: Section 4.2.2.2, Page 4-13, Lines 27: Change "northwest" to "northeast". (**0134-27** [Fallon, Chris])

Response: *Section 4.2.2.2 of the EIS was revised to reflect these comments.*

E.2.7 Comments Concerning Terrestrial Ecology

Comment: 4.3.1.1 Terrestrial Resources -Site and Vicinity, Wetlands and Streams: See comments in section 2.4.1.2. Terrestrial Resources-Make-Up Pond C Site. (**0126-19** [Vejdani, Vivianne])

Comment: 4.3.1.2 Terrestrial Resources -The Make-Up Pond C Site See comments in Section 2.4.1.2 Terrestrial Resources-Make-Up Pond. (**0126-32** [Vejdani, Vivianne])

Comment: 4.1.2 The Make-Up Pond C Site: See comments in section 2.4.1.2 Terrestrial Resources-Make-Up Pond C Site. (**0126-33** [Vejdani, Vivianne])

Comment: Significant Natural Areas
The presence of the many rare plant communities described in this section attest to the integrity of the London Creek site. (**0126-4** [Vejdani, Vivianne])

Comment: Noteworthy Natural Community Types and Rare Plant Species

The presence of noteworthy community types, such as mountain coves and bluffs, and rare plant species further points to the resource value and relative integrity of the London Creek site. (**0126-5** [Vejdani, Vivianne])

Comment: Wildlife

As observed by DNR during its December 2009 site assessment and as revealed in the surveys conducted by the Licensee's agents, the London Creek site is a relatively undisturbed Piedmont bottomland hardwood system comprised of quality micro habitats hosting a number of rare and sensitive species. Many of these habitat types are becoming increasingly rare in the upstate and are under increasing pressure from development. The proposed Make-up Pond C would remove a significant amount of bottomland hardwood habitat and the transitional areas adjacent to it. Riparian corridors such as that along London Creek are important for connectivity at the landscape scale and serve as migration corridors for wildlife and neotropical migrating birds. (**0126-6** [Vejdani, Vivianne])

Response: *These comments support the description of and potential impacts to bottomland hardwood forest in the London Creek watershed, its microhabitats, its general use by wildlife, and its use as a travel corridor by neotropical migrant birds. Additional information on the habitats associated with London Creek and the use of those habitats by birds and other wildlife has been added to Sections 2.4.1.2 and 4.3.1.2.*

Comment: My position [opposition] is based on... The PROXIMITY to my home, which happens to be in one of the most Biologically diverse areas of the world, which could be potentially be destroyed by this project. (**0047-5** [Lauden, Loy])

Response: *Potential impacts to terrestrial habitat diversity and species diversity in the vicinity of the Lee Nuclear Station site are addressed in Section 4.3.1 of the EIS. No changes were made to the EIS as a result of this comment.*

Comment: The problem of the proposed nuclear power plant requiring the destruction of a sizeable area of woodlands and natural resources. (**0119-4** [Thomas, Ruth])

Response: *Potential impacts to forest habitat and associated wildlife resources in the vicinity of the Lee Nuclear Station site are addressed in Section 4.3.1 of the EIS. No changes were made to the EIS as a result of this comment.*

Comment: [The following problems are among those we have identified:] The disruption of bird migrations, as mentioned in the EIS. (**0119-6** [Thomas, Ruth])

Response: *Potential impacts to wildlife travel corridors in the vicinity of the Lee Nuclear Station site and their use by migratory birds are addressed in Section 4.3.1 of the EIS. No changes were made to the EIS as a result of this comment.*

Comment: Waters of the United States and Upland Habitats

The DEIS indicates that the Licensee has consulted with the USACE Charleston District in the development of a compensatory mitigation plan in conformance with the 2002 Standard Operating Procedure for Compensatory Mitigation (SOP). The 2002 SOP has been superseded by the Guidelines for Preparing a Compensatory Mitigation Plan, October 2010 revision (2010 Guidelines). All compensatory mitigation should be developed in conformance with the 2010 Guidelines. (**0126-22** [Vejdani, Vivianne])

Response: *Section 4.3.1.7 of the EIS (Section 4.3.1.6 in the draft EIS) was revised to state that the Licensee has consulted with the USACE to develop a compensatory mitigation plan in conformance with the requirements of the USACE Charleston, South Carolina District* Guidelines for Preparing a Compensatory Mitigation Plan *(USACE 2010) and* Compensatory Mitigation for Losses of Aquatic Resources*;* Final Rule *(73 FR 19594, 40 CFR Part 230 and 33 CFR Part 332).*

Comment: 2.4.1.5 Important Terrestrial Species and Habitats

A number of state listed plant and animal species occur within the footprint of Make-Up Pond C and the transmission line and railroad corridors. Impacts to individuals and/or habitat of conservation priority species should be avoided to the greatest extent practicable. Where appropriate, the Licensee should consult with DNR on potential relocation of conservation priority plant species populations that may be impacted by construction. (**0126-11** [Vejdani, Vivianne])

Response: *This comment supports the discussion of mitigation of impacts to State-ranked plant species presented in Section 4.3.1 of the EIS, which includes consultation with the SCDNR regarding the potential relocation of those species. No changes were made to the EIS as a result of this comment.*

Comment: 4.1.3.1 Transmission Line Corridors
See comments in section 2.4.1.3 Transmission Line Corridors. (**0126-17** [Vejdani, Vivianne])

Comment: 4.3.1.3 Terrestrial Resources - Transmission-Line Corridors
See comments in section 2.4.1.3 Transmission Line Corridors.
(**0126-21** [Vejdani, Vivianne])

Comment: 5.1.2 Transmission-Line Corridors and Off-site Areas

See comments in section 2.4.1.3. Transmission Line Corridors.
(**0126-25** [Vejdani, Vivianne])

Comment: 2.4.1.3 Transmission Line Corridors
The Licensee proposes to build 4 new transmission lines along Routes K and 0 to their respective tie-in locations on the existing 230-kV Pacolet Tie-Catawba line, located approximately 7 mi south of the site and the existing S2S-kV Oconee-Newport line, located approximately 15 mi south of the site. Clearing impacts from the construction of the transmission line corridors will permanently remove wildlife habitat. Bottomland hardwood habitats support an array of wildlife species due to the abundance of fruiting and flowering plants and an abundance of natural cover for animals. Mast-producing hardwood tree species such as oaks and hickories provide an abundant and reliable food source, tree cavities characteristic of mature hardwood trees provide preferred nest and den sites, and snags and downed woody debris provide food sources and cover for a variety of wildlife including invertebrates, reptiles, amphibians, birds and mammals. Bottomland hardwood forests also provide travel corridors for mammals and nesting, migration and winter habitat for birds. Many birds use bottomland hardwood forests as nesting, foraging, migration and winter habitat. These birds include resident birds as well as Neotropical and Nearctic migrants. Resident and migratory waterfowl also utilize flooded bottomland hardwood habitats as nesting, brood-rearing, foraging or roosting areas.

Upland hardwood forests and mixed pine-hardwood forests support many of the same species as bottomland hardwood forests, with the exception of those species which are wetland obligates. Species of highest conservation priority in South Carolina which inhabit or utilize upland hardwood forest or bottomland hardwood forest include: Eastern wood pewee (*Contopus virens*), Kentucky warbler (*Oporornis formosus*), black-throated green warbler (*Setophaga virens*), little blue heron (*Egretta caerulea*), yellow-crowned night heron (*Nyctanassa violacea*), rusty blackbird (*Euphagus carolinus*), Swainson's warbler (*Limnothlypis swainsonii*), swallow-tailed kite (*Elanoides forficatus*), wood thrush (*Hylocichla mustelina*), worm-eating warbler (Helmitheros vermivorum), black bear (*ursus americanus*), and northern yellow bat (*Lasiurus intermedius*). (**0126-9** [Vejdani, Vivianne])

Response: *Section 2.4.1.3 was revised to emphasize wildlife assemblages that likely occur in the habitats where the new transmission-line corridors will be built. The information in the "wildlife" subsection of Section 2.4.1.3 was moved to Section 4.3.1.3 as it is a better reflection of wildlife species that likely would occupy new transmission-line corridors after they have been built. Information on wildlife assemblages in the existing habitats where the transmission-line corridors would be constructed was inserted into the "wildlife" subsection of Section 2.4.1.3.*

Comment: Grassland birds are among the most steeply declining of all bird populations in North America due to loss and degradation of grassland and shrub-scrub habitats. Transmission corridors can provide significant habitat for grassland birds, as well as raptors and small mammals, by functioning as linear grassland/shrublands. Excellent wildlife habitat, as well as safe and efficient power delivery, can be provided by managing these areas as a combination of native grasses, forbs, and small shrubs through direct seeding or natural regeneration. Any direct seeding of corridors should utilize only native plant materials. Sod-forming grasses like Bermuda grass and fescue and aggressive non-native forbs provide poor wildlife habitat along the right-of-way and can potentially escape to adjacent woodlands or fields resulting in additional habitat degradation. DNR recommends that where possible lands within transmission line corridors should be managed for the benefit of wildlife.
(**0126-10** [Vejdani, Vivianne])

Response: *These recommendations from the SCDNR are directed to the applicant, therefore no changes were made to the EIS as a result of this comment.*

Comment: Amphibian and Reptiles
The diverse amphibian assemblage documented at the London Creek site is an indication of the relatively high environmental integrity of this site. Amphibians, as a group, represent tangible linkages between aquatic, wetland and terrestrial habitats and are dependent upon some type of aquatic habitat for all or a part of their Iifecycle. Therefore, the diversity of aquatic habitat such as that located at the London Creek site (e.g., stream channel, small tributaries, seepage wetlands, isolated wetlands, floodplain, rocky outcrops and bluffs) is important in maintaining high amphibian diversity.
(**0126-7** [Vejdani, Vivianne])

Response: *This comment supports statements made in Section 2.4.1 of the EIS regarding the link between diverse amphibian populations and diverse aquatic and adjoining terrestrial habitats in the London Creek watershed, and in Section 4.3.1 of the EIS regarding the environmental integrity of the London Creek site. No changes were made to the EIS as a result of this comment.*

Comment: Salamanders and Newts
DNR notes that the mud salamander (*Pseudotriton montanus*), four-toed salamander (*Hemidactylium scutatum*) and three-lined salamander (*Eurycea guttolineata*) are salamander species as-of-yet not documented at the site, posing a particular challenge to survey as they are highly fossorial, have specific habitat requirements and may be present on the surface only during breeding. These species are more likely to be documented through a longer duration surveyor through use of a survey methodology such as drift fence arrays with pitfall traps. Salamanders are highly sensitive to changes in water quality and canopy structure, soil moisture regimes and oxygen content in water; changes in anyone or a combination of these parameters may result in significant habitat degradation, rendering it unsuitable for many

salamander species. This does not appear to be the case at London Creek, as the herpetological survey documented that 8 of the 11 potential salamander species (72%) that could potentially occur have been documented onsite. It is DNR's opinion that the salamander assemblage at London Creek is indicative of a healthy and functional system. (**0126-8** [Vejdani, Vivianne])

Response: *This comment supports statements made in Section 2.4.1 of the EIS regarding the diversity of amphibian populations in the London Creek watershed, and in Section 4.3.1 of the EIS regarding the environmental integrity of the London Creek site. Section 2.4.1 of the EIS was revised to indicate that although the mud salamander (*Pseudotriton montanus*), four-toed salamander (*Hemidactylium scutatum*), and three-lined salamander (*Eurycea guttolineata*) have yet to be documented at the London Creek site, they are likely to occur at the London Creek site based on habitat integrity and the difficulty detecting these species due to their fossorial behavior.*

Comment: As indicated in the DEIS, in November 2011 Duke Energy submitted an application to the Charleston District of the U.S. Army Corps of Engineers (USACE) to request authorization for the placement of dredged or fill material in waters of the U.S. under Section 404 of the Clean Water Act. This permit application provides updated wetland, open water, and stream impact acreages and linear feet for the William States Lee III Nuclear Station project. In the future, as the 404 permitting process continues, Duke Energy will provide the NRC written correspondence made to the USACE during the EIS process. (**0134-1** [Fallon, Chris])

Response: *Sections 4.3.1 and 4.3.2 of the EIS were updated to reflect the most recent 404 permitting process correspondence between Duke and the USACE.*

Comment: Section 2.4.1.1, Page 2-39, Line 24: The NRC uses reference (USACE 2007a) to describe jurisdictional or non-jurisdictional wetlands in the DEIS. This reference has been superseded by a more recent jurisdictional determination, the results of which are summarized in the August 23, 2011 email from Richard Darden to Sarah Lopas (DEIS reference USACE 2011). (**0134-7** [Fallon, Chris])

Response: *Sections 2.4.1, 2.4.2, 4.3.1, 4.3.2, 5.3.1, and 9.5.2 of the EIS were updated to reflect the most recent information on jurisdictional wetlands from the USACE (USACE 2013).*

Comment: Section 4.3.1.2, Pages 4-35, Line 1: The use of "state rank" used throughout the document needs to be defined carefully and in greater detail and also needs to be clarified in comparison with federal and state legal status listings (threatened, endangered, etc.). "State ranks" are not referred to as "listings". Also, "state ranks" should preferably be used in all cases in combination with global conservation status ranks (G5- demonstrably secure globally) to provide a more complete understanding of important species and habitat considerations. "Listings" include the federal and state legal status for plants and wildlife (e.g., FE-federal

endangered, SE-state endangered and SC-state species of concern). In addition, references to conservation priority species under the South Carolina Comprehensive Wildlife Conservation Strategy (SCDNR 2005) also need to be clearly defined early on in the document, and differentiated from listed species and conservation status rankings. Finally, the state listing status of "species of state concern (SC)" is not used anywhere in the document, perhaps because this entry is not included in the currently available on-line list of species tracked by SCDNR's state natural heritage program (SCDNR 2010a): however, this designation is still used in some materials listed on the SCDNR website. [Also, in] Section 7.3.1.4, Page 7-25, Lines 32-35: As previously discussed (Comment #35), "State ranks" and other designations need to be clearly defined to avoid confusion.
(**0134-34** [Fallon, Chris])

Response: *Global rankings were added in Sections 2.4.1, 2.4.2, and 4.3.1. The terminology "species of concern" is not used in the EIS because it is not an official designation for South Carolina (SCDNR 2011) and it was not used by SCDNR in the source documents referenced in the EIS. Nevertheless, for clarity, the introductory portion of Section 2.4 was revised to include more-detailed and comparative definitions of State and global ranking, State and Federal listing, State conservation priority, and Atlantic Coast Joint Venture priority.*

Comment: Section 4.3.1.3, Page 4-38, Line 33: The main transmission lines leaving Lee Nuclear Station are two 230 kV and 525 kV lines. On line 33 one is listed as a 520 kV line. This needs to be changed to a 525 kV line. (**0134-37** [Fallon, Chris])

Response: *Section 4.3.1.3 of the EIS was revised to reflect the appropriate voltage of the 525-kV switchyard on the Lee Nuclear Station site.*

Comment: Section 4.3.1.6, Pages 4-48, Line 15: This reference is out of date. The reference should be the 2010 Guidelines for Preparing a Compensatory Mitigation Plan (USACE October 2007). (**0134-39** [Fallon, Chris])

Response: *Section 4.3.1.7, formerly Section 4.3.1.6, of the EIS was revised to include the 2010 Guidelines for Preparing a Compensatory Mitigation Plan (USACE 2010).*

Comment: Section 4.3.1.6, Page 4-48, Lines 33, 34: Hydrologic Unit Codes (HUCs) for Upper and Lower Broad River should be included as well. (**0134-40** [Fallon, Chris])

Response: *Section 4.3.1.7, formerly Section 4.3.1.6, of the EIS was updated to reflect the latest information regarding proposed wetland and stream mitigation.*

Comment: Section 4.3.1.7, Page 4-50, Line 4: At the end of the sentence that references the USACE 404 requirements for the permitting process associated with the discharge of dredge or fill material, add "without a permit from the US Army Corps of Engineers." This clarifies that the discharge of dredge or fill is allowed with a 404 permit. (**0134-42** [Fallon, Chris])

Response: *Section 4.3.1.8, formerly Section 4.3.1.7, of the EIS was revised to state, "Duke stated that it would work with the USACE to determine appropriate mitigation through the permitting process of Section 404 of the CWA (33 U.S.C. 1344), which prohibits the discharge of dredged or fill material into waters of the United States without a Department of the Army permit."*

Comment: Section 7.3, Page 7-21, Line 13: Duke Energy notes that a cumulative effects discussion on wetlands and streams in the context of the Clean Water Act Section 404(b)(1) Guidelines was included in the Section 404 permit application submitted to the U.S. Army Corps of Engineers on November 15, 2011. Additionally, the compensatory mitigation provided as part of the 404 permitting process accounts for cumulative impacts using a Cumulative Impact Factor to calculate the mitigation credit need. The stream mitigation also includes the preservation, enhancement, and/or restoration of substantial forested stream buffers, which relates to the lowland hardwood/riparian forest considerations expressed in Chapters 7 and in Chapter 4. (**0134-58** [Fallon, Chris])

Response: *Section 7.3.1. of the EIS states that Duke is developing, through consultation with the USACE, a compensatory mitigation plan addressing wetland and stream impacts that conforms with USACE guidelines. Additional information is provided in Section 4.3.1.7 (formerly Section 4.3.1.6) of the EIS.*

Comment: Section 7.3.1.1, Page 7-22, Line 30: Change "several State parks" to "several state and national parks". The Kings Mountain National Military Park includes large natural areas and is roughly 4,000 acres in size, including large tracts of contiguous forest and small streams. This national park directly abuts Kings Mountain State Park. Both parks are also nearly contiguous with Crowders Mountain State Park, with stands of hardwood forest connecting all 3 parks. (**0134-59** [Fallon, Chris])

Comment: Section 7.3.1.1, Page 7-23, Lines 19-20: Change "...State parks" to "state and national parks". (**0134-61** [Fallon, Chris])

Response: *Section 7.3.1.1 of the EIS was revised to include Kings Mountain National Military Park, Kings Mountain State Park, and Crowders Mountain State Park.*

Comment: Section 7.3.1.1, Page 7-23, Lines 9-10: The 530 acres of impact refers to permanent and temporary impacts to mixed hardwoods and mixed hardwood/pine forests within the Make-Up Pond C study area not lowland mixed hardwood forest and mixed hardwood/pine forest. Lowland mixed hardwood forest is one of four subtypes within the mixed hardwoods community. The separate subtypes were not mapped separately from the mixed hardwoods as they could not be distinguished on aerial photographs. The mixed hardwood forest contained other subtypes such as recently cut-over mixed hardwoods and upper and mid-slope mixed hardwood. (**0134-60** [Fallon, Chris])

Response: *Section 7.3.1.1 of the EIS was revised to state that site preparation and development at the Make-Up Pond C site would disturb approximately 545 ac of mixed hardwood forest and mixed hardwood-pine forest, instead of lowland mixed hardwood forest and mixed hardwood-pine forest. The impact acreage was updated to reflect the latest design data received from Duke (Duke 2013).*

Comment: Section 9.3.5.3, Page 9-167, Lines 24-25: The DEIS states: "Wetlands do not occur within this area at the Middleton Shoals site (Duke 2009c)." Duke 2009b revised Duke 2009c to show that 1.2 ac of wetlands are estimated to occur onsite. (**0134-81** [Fallon, Chris])

Response: *Section 9.3.5.3 of the EIS was revised to include an estimated 1.2 ac of wetlands on the Middleton Shoals site based on Duke (2009a).*

Comment: Section 9.3.5.3, Page 9-168, Line 32: The reference "(Duke 2010)" should be "(Duke 2010g)". (**0134-82** [Fallon, Chris])

Response: *The requested change was made to Section 9.3.5.3 of the EIS.*

Comment: Land Clearing: It appears a total of 22 miles of bottomland hardwood will be cleared to build four new transmission lines. Bottomland hardwood habitats support a large array of wildlife species. Clearing the land will permanently remove wildlife habitats producing an abundance of food sources, flowering plants, and natural cover for animals including invertebrates, reptiles, amphibians, birds and resident and migratory waterfowl. The SC Wildlife Federation recommends that the applicant work closely with SC DNR to ensure these corridors are managed to maximize wildlife habitat by using native grasses, small shrubs, and native plant materials. (**0135-5** [Gregg, Ben])

Response: *These statements from the South Carolina Wildlife Federation are directed to the applicant and the SCDNR; therefore, no changes were made to the EIS.*

Comment: Additional concerns include impacts to approximately 1,200 total acres of terrestrial and wetland habitats. (**0141-2** [Caldwell, Mark] [Stanley, Joyce A.])

Response: *Construction and operation impacts to terrestrial and wetland habitats are discussed in Sections 4.3.1 and 5.3.1 of the EIS, respectively. No changes were made to the EIS as a result of this comment.*

Comment: *Recommendations*: EPA recommends that the FEIS contain updated information including the wetland mitigation plan and the status of the permitting process. (**0142-12** [Mueller, Heinz])

Response: *EIS Section 4.3.1.6, now Section 4.3.1.7, was revised to reflect the most recent information available on the status of the CWA Section 404 permitting process and the Compensatory Mitigation Plan.*

Comment: Measures to minimize impacts should be documented and committed to in the decision documents. We recommend that the following measures be considered to further minimize impacts to wetlands during construction:

Perform construction in wetlands during frozen ground conditions, if feasible;

Minimize width of temporary access roads;

Use easily-removed materials for construction of temporary access roads (e.g., swamp/timber mats) in lieu of materials that sink (e.g., stone, rip-rap, wood chips);

Use swamp/timber mats or other alternative matting to distribute the weight of the construction equipment. This will minimize soil rutting and compaction;

Use vehicles and construction equipment with wider-tired or rubberized tracks or use of low ground pressure equipment to further minimize impacts during construction access and staging;

Use long-reach excavators, where appropriate, to avoid driving, traversing, or staging in wetlands; and

Place mats under construction equipment to contain any spills.

(**0142-14** [Mueller, Heinz])

Response: *As discussed in Sections 4.3.1, 4.3.2, and 4.11 of the EIS, Duke has stated that site preparation and development activities would be conducted in accordance with Federal and State regulations and permit requirements, adoption of a Stormwater Pollution Prevention Plan and a Spill Prevention, Control, and Countermeasure Plan, and use of BMPs. These specific measures to minimize impacts to wetlands during site-preparation and development activities are directed to the applicant; therefore, no changes have been made to the EIS.*

Comment: Section 4.3.1.4, Page 4-43, Lines 32-33: Mountain lions no longer inhabit the Carolinas (Webster 2009). No suitable habitat for red-cockaded woodpecker occurs in the study area. The cited reference does not pertain to this species. (**0134-38** [Fallon, Chris])

Response: *The mountain lion and red-cockaded woodpecker were removed from EIS Sections 2.4.1.5 (cited incorrectly in the comment as Section 4.3.1.4) and 4.3.1.5, now Sections 2.4.1.6 and 4.3.1.6, respectively, and Table 2-9.*

Comment: Section 4.3.1.2, Page 4-34, Lines 27-34: The five referenced ecological community types originate from the national vegetation classification system, which very specifically defines ecological units using detailed information on landforms, soils, hydrology, and floristics. A comparison could be made between the plot data in Gaddy 2009 and descriptions of these communities made in NatureServe Explorer 2010. A specific example is floodplain canebrake which is defined as "large expanses of giant cane on floodplains without overstory trees (no trees present), probably maintained by fire". Though there are locations in the study area that include giant cane in the understory, these areas include an overstory of hardwood trees and are not fire maintained. (**0134-32** [Fallon, Chris])

Response: *The SCDNR documented the existence of five noteworthy natural community types in the London Creek study area during the agency's field visits. These five community types were not discussed in the Gaddy (2009) study. Thus, the locations of the five community types are likely different from the locations of the Gaddy (2009) study plots, and therefore would not be comparable. NatureServe Explorer (2010) notes the following regarding the classification of the floodplain canebrake ecological association, "Historical accounts refer to both 'pure' stands of cane without an overstory of trees (cane shrublands) and areas with variable overstory closure (woodlands or forests) but with a dense understory dominated by cane as 'canebrakes.' As currently described [NatureServe Explorer 2010], this association refers only to the former, cane shrublands. " However, the summary description of the association states that, "Stands occur on alluvial and loess soils and are often associated with bottomland hardwood forest vegetation. This association is successional and is thought to be maintained by periodic fires. It may have originated following abandonment of aboriginal agricultural fields or other natural and anthropogenic disturbances such as blow-downs and catastrophic floods." It is unclear from the NatureServe Explorer (2010) excerpts whether the floodplain canebrake that occurs in the bottomlands of London Creek is part of the floodplain canebrake ecological association. Section 2.4.1.2, where the natural community types are described, was revised to note this ambiguity and other such inconsistencies regarding the other four noteworthy natural community types.*

Comment: Section 4.3.1.2, Pages 4-34, Line 30: Reference SCDNR 2011a appears to be incorrect here and in several other locations in text. Refer to references section of DEIS. This citation corresponds to a reference for black bears in SC. This reference should likely be SCDNR 2011b. Additionally [in Section 7.3.1.4, Page 7-25, Lines 32-35], the SCDNR 2011a reference is incorrect. The reference should be SCDNR 2011c. (**0134-33** [Fallon, Chris])

Response: *The reference for black bears has been revised to SCDNR (2005) in the EIS. The SCDNR references in Sections 4.3.1.2, 4.3.2.3, and 7.3.1.4 of the EIS were also revised as necessary.*

Comment: The secondary and cumulative impact potential of the proposed Lee Nuclear Station is significant and the zone of influence would extend beyond the direct footprint of the impact zone. The loss of approximately 1,500 acres of forest for the development of the Lee Nuclear Station would result in the loss of quality Piedmont plant communities that are becoming increasingly rare, such as seepage swamp, floodplain canebrake, Piedmont acidic mesic mixed hardwood forest and Piedmont beech/heath bluff'. Also located within the footprint of Make-Up Pond C were 5 conservation priority plant species: drooping sedge (*Carex prasina*), southern enchanter's nightshade (*Circaea lutetiana* ssp. Canadensis), southern adder's-tongue fern (*Ophioglossum vulgatum*), Canada moonseed (*Menispermum canadense*), and single-flowered cancer root (*Orobanche uniflora*). Lee Nuclear Station operations may also impact sensitive and/or rare aquatic species. Nine state conservation priority fish species have been documented within the Ninety-Nine Islands Reservoir (see section 2.4.2.1 Aquatic Resources - Site and Vicinity). Nearly 7 miles of London Creek and associated riparian forest would be permanently lost, and there would be permanent conversion of terrestrial and aquatic habitat to a shrub, scrub community for the construction of 31 miles of new transmission line corridor. As noted by the Review Team, the construction of the Lee Nuclear Station would result in forest fragmentation, loss of connectivity for migrating wildlife and degradation and/or loss of aquatic and forested habitat, with a concomitant loss of plant and animal species dependent upon these habitats. Due to the magnitude of impacts associated with Make-Up Pond C and transmission line corridors, the Review Team has classified the impact to terrestrial and aquatic resources as MODERATE. However, the Review Team concludes even individual impacts classified as SMALL can be important if they contribute to or accelerate the overall resource decline. A thorough accounting of all impacts, including direct, secondary and cumulative impacts should be undertaken by the Licensee. In keeping with the Memorandum of Agreement between the Environmental Protection Agency and the USACE on The Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines, the Licensee must provide compensatory mitigation commensurate with the quality impacted. DNR will endeavor to work with the Licensee and natural resource land regulatory agencies to assist the Licensee in identifying appropriate mitigation opportunities that adequately replace lost functions of London Creek and its watershed due to construction of the proposed Lee Nuclear Station. (**0126-28** [Vejdani, Vivianne])

Response: *These statements are directed to the applicant. EIS Section 4.3.1.6, now Section 4.3.1.7, has been revised to reflect the most recent information available on compensatory mitigation to replace the lost functions of London Creek and its riparian corridor on a watershed scale.*

Comment: Section 4.3.1.1, Page 4-22, Lines 15: Change "northeast" to "southeast". (**0134-29** [Fallon, Chris])

Response: *The referenced line states that the intake structure would be located southeast of the alluvial wetland, not northeast. However, a comparison of Figures 2-5 and 6-9 in Volume I of the* William S. Lee III Nuclear Station Joint Application for Activities Affecting Waters of the United States *(Duke 2011c) makes it clear that the intake structure would be located northeast of the alluvial wetland. Section 4.3.1 of the EIS was updated to reflect the location of the intake structure.*

Comment: Section 4.3.1.1, Page 4-19, Line 13: Dates require update - 2012 to 2014 and 2014 to 2016. This change was previously noted in a letter dated March 31, 2010 from Bryan Dolan to the NRC Document Control Desk (ML100920024). (**0134-28** [Fallon, Chris])

Response: *EIS Section 4.3.1 was updated to reflect the most recent schedule for site-preparation activities provided by Duke.*

Comment: Section 4.3.1.2, Page 4-30, Line 26-37: The basis for the statements in the DEIS regarding lowland mixed hardwoods along London Creek is not clear. No data, measurements, or figures are presented for the comparisons made in the DEIS regarding the width and contiguity of lowland mixed hardwoods along London Creek versus other creeks in the area. In Chapter 2 of the DEIS, there is no related presentation or discussion of the width or contiguity of lowland mixed hardwood forest in the study area. Some of this discussion in Chapter 4 also conflicts with information presented in Chapter 2 of the DEIS (see page 2-65 for instance, which may be overstated in the opposite direction).

Information in Chapters 2 and 4 of the ER Supplement indicate that lowland mixed hardwood forest along London Creek would be considered relatively common, in moderate to good condition, and comparable to lowland mixed hardwood forests occurring along other creeks throughout the region. Some creeks may have narrower or less contiguous stands of lowland mixed hardwood forests and others may exceed London Creek in these characteristics, but London Creek would not stand out as substantially better compared to other locations. (**0134-30** [Fallon, Chris])

Response: *The habitat information provided in EIS Section 2.4.1.2 relative to the bird study of London Creek watershed refers to bottomland hardwood forest (subset of lowland hardwood forest which also comprises hardwood forest on lower slopes and in riparian and seepage areas) providing the highest quality avian habitat and species diversity among the habitats under study, although it is fragmented and of limited size. This was not a comparison of the London Creek bottomland hardwood forest with that of streams of similar size in the area. Section 2.4.1.2 of the EIS was revised to clarify this point. The generic condition of lowland (including bottomland) hardwood forest being fragmented and of limited size is typical among* *streams in the Piedmont of South Carolina. The issue is the condition of the London Creek lowland hardwood forest relative to that of other streams of similar size in the area. The evaluation in Section 4.3.1.2 of the EIS that discusses impacts to lowland hardwood forest was qualitative, based on visual interpretation of vegetation maps. To clarify, Section 4.3.1.2 of the EIS was revised to include a simple quantitative assessment of the vegetation types/land-cover classes within the corridor of London Creek and the six other streams (Doolittle Creek, Cherokee Creek, Bells Branch, Nells Branch, Kings Creek, and Abingdon Creek). Acreages of the vegetation types/land-cover classes within the corridor of each stream were compared to elucidate the percent cover and contiguity of lowland hardwood forest among these streams.*

Comment: Section 4.3.1.2, Pages 4-33, Lines 35-36: Some of the areas described as Significant Natural Areas (SNA) in the DEIS do not contain rare plants or rare plant communities. Some of the SNAs are described as being dominated by relatively common to abundant species. Plant species that are relatively common to abundant and are "secure" from a conservation perspective, but that are slightly outside their usual ranges, are perhaps interesting, but are not particularly significant (e.g., mountain laurel). Individual mature trees do not constitute significant resources. It is doubtful that old-growth trees exist on the site, and old-growth forest stands definitely do not occur near London Creek. Some of the SNAs also describe wetlands that are included elsewhere in the DEIS. (**0134-31** [Fallon, Chris])

Response: *The descriptions of the significant natural areas (SNAs) and the bases for their identification as significant were provided by Duke's independent botanical consultant and summarily incorporated in the EIS. An SNA may consist of one or a combination of the following: a rare plant community; rare plant species; and mature to old-growth trees. The term "significant natural area" as used in the EIS has no regulatory basis, but is a matter of professional judgment. For example, mountain laurel (*Kalmia latifolia*) is a common shrub species in Piedmont hardwood forests; however, it is unusual that it completely dominates the hardwood tree component of the community as it does in the Laurel Ravine SNA in the London Creek study area. In addition, mature to old-growth trees in the London Creek bottomland hardwood forest have attained great age without significant disturbance. A community containing such trees, particularly multiple species, such as the West Bluff SNA, may be considered rare in a landscape otherwise dominated by monocultures of trees of much lesser stature due to frequent timber harvest. A defensible rationale likewise exists for the other eight SNAs in the London Creek study area. No changes were made to the EIS based on this comment.*

Comment: Section 4.3.1.2, Page 4-35, Lines 7-14: The statements in this summary paragraph regarding the diversity and integrity of the habitat types in question and the importance, rarity, or scarcity of these resources is questionable. The presence of similar significant natural areas, natural community types, and rare plant species in other locations outside Make-Up Pond C, including on the Lee site, and in the transmission corridor crossing Abingdon Creek, indicate these resources are likely common in the region. All but one of the rare plant species included in the significant natural areas and in subsequent sections of this chapter, were recently recorded at Kings Mountain National Military Park (White and Govus 2005), as were many other species of greater rarity or imperilment that were not recorded in the Make-Up Pond C study area. This also indicates that the significance of these resources in the Make-Up Pond C area may be somewhat overstated. (**0134-35** [Fallon, Chris])

Response: *Ten SNAs, four noteworthy ecological associations, five State-ranked plant species, and five uncommon plant species were observed in the Make-Up Pond C study area, whereas only one State-ranked plant species was observed on the Lee Nuclear Station site and along Abingdon Creek near where it would be crossed by the transmission lines (about 5 mi southwest of the Lee Nuclear Station site). The Make-Up Pond C study area, Lee Nuclear Station site, and the transmission-line corridors are similar in size, but there are differences in land and water features that make them not completely comparable. However, a far greater number of rare vegetation elements were observed in the Make-Up Pond C study area than were observed in the other two areas. These rare plant species and communities may be present elsewhere in the region; however, it is extraordinary that they would occur concentrated in one area unless that area had relatively high habitat integrity. For example, Kings Mountain National Military Park, located 10 mi northeast of the Lee Nuclear Station site and approximately twice the size of the Make-Up Pond C study area, has been disturbed by silviculture and agriculture but has been recovering from human disturbance for at least 50 years since creation of the park, and is buffered on all sides by Kings Mountain State Park. The fact that all but one of the State-ranked plant species observed in the Make-Up Pond C study area has also been recently observed at Kings Mountain National Military Park (White and Govus 2005) supports the relative integrity of the London Creek bottomland hardwood forest. Sections 2.4.1 and 4.3.1 of the EIS were revised, where appropriate, to include information from the Kings Mountain National Military Park vegetation assessment (White and Govus 2005).*

Comment: Section 4.3.1.6, Page 4-49, Lines 29-33: This paragraph references the on-site mitigation measures planned using BMPs. Make-Up Pond C and State roads should also be mentioned, in addition to the Lee Nuclear Station site, the transmission line and railroad corridors. (**0134-41** [Fallon, Chris])

Response: *The paragraph in EIS Section 4.3.1.6, now Section 4.3.1.7, was revised to include the Make-Up Pond C study area and the offsite road-improvement areas. In addition, a new subsection "Offsite Road Improvements" was inserted into EIS Section 4.3.1 that covers impacts to State roads and identifies the BMP practices that will be followed (Duke 2011c).*

Comment: Wetlands
The site preparation and development of the proposed Lee Nuclear Station and associated facilities would potentially impact wetlands and streams regarded as Aquatic Resources of National Importance (ARNI). Page 7-24 notes that approximately 5.5 acres of wetlands are involved. The wetlands impacts include 0.21 acres at Lee Nuclear Station site; 3.66 acres at

Make-up Pond C; and 1.57 acres of wetland impacts resulting from transmission lines, pipelines and the railroad spur. A majority of the impacts to Waters of the United States associated with the project are due to "Drought Contingency Pond C" (Pond C). This pond proposes to permanently impact 65,056 linear feet of stream and 4.07 acres of wetlands. (**0142-10** [Mueller, Heinz])

Response: *Sections 4.3.1, 4.3.2, 5.3.1, 5.3.2, 7.3.1, and 7.3.2 were revised to include the most recent information on wetland and stream impacts from the 404(b)(1) analysis included in Section 9.5 of the EIS.*

Comment: Endangered and Threatened Species
The DEIS summarizes the NRC's coordination with the U.S. Fish and Wildlife Service (FWS), noting the presence of three listed and one candidate species in Cherokee, Union, and York Counties, which encompass the Lee Nuclear Station site, the Make-Up Pond C site, the two proposed transmission-line corridors, and the railroad-spur corridor (page 4-43). There are no areas designated by the FWS as critical habitat for Federally listed threatened and endangered species in the area of the proposed Lee Nuclear Station and supporting infrastructure (page 5-21).

Recommendations: EPA defers to the FWS and the State wildlife agencies on these issues and recommends that the FEIS should provide updated information regarding the consultation process with the FWS. (**0142-24** [Mueller, Heinz])

Response: *As discussed in Section 4.3.1 of the EIS, the U.S. Fish and Wildlife Service (FWS) concurred, in a letter dated June 13, 2012, with the NRC review team's determination that the proposed Lee Nuclear Station Units 1 and 2 project (all elements) is not likely to adversely affect Federally protected species nor result in adverse modification to designated or proposed critical habitat, thus completing informal consultation between the FWS and NRC (FWS 2012). Consultation correspondence between the review team and FWS is listed in Appendix F.*

Comment: CHAPTER 2 -AFFECTED ENVIRONMENT 2.2.2. The Make-Up Pond C Site
The Licensee proposes a 300-ft buffer around Make-Up Pond C, 50 ft of which is proposed to be cleared, grubbed, grassed and maintained to prevent debris from washing into the reservoir. DNR concurs with the proposed 300-ft buffer but does not support maintaining a grassed 50-ft shoreline buffer. If a natural shoreline buffer is maintained, Make-Up Pond C likely would naturalize and support a greater variety of aquatic life and wildlife. Riparian zones perform numerous ecological functions including providing food, cover, and nesting sites for a variety of wildlife species as well as detritus and woody debris which are an important source of energy and cover for aquatic life. Canopy cover helps to maintain water quality by reducing surface water temperatures and evaporative loss. Riparian zones function as biofilters and remove nutrients and other pollutants from storm-water runoff before it enters rivers, lakes and streams. Maintenance of the 50-ft buffer likely will contribute to lowered water quality. DNR recommends

the Licensee explore alternatives for preventing debris from entering intake structures in order to protect water quality, maximize wildlife habitat and reduce evaporative losses. (**0126-1** [Vejdani, Vivianne])

Comment: 4.1.2 The Make-Up Pond C Site: See comments in section 2.2.2 The Make-Up Pond C Site. (**0126-16** [Vejdani, Vivianne])

Comment: 4.3.1.2 Terrestrial Resources -The Make-Up Pond C Site See comments in sections 2.2.2. The Make-Up Pond C Site. (**0126-30** [Vejdani, Vivianne])

Comment: The Drought Contingency Pond C Buffer Zone: While SC Wildlife Federation applauds the proposed 300 feet buffer zone around the pond, we recommend DNR work closely with the applicant to enhance the 300 feet buffer and its functionality to provide excellent food, cover and nesting sites for the local wildlife species. (**0135-3** [Gregg, Ben])

Response: *These comments are specific recommendations directed to the applicant by the SCDNR and the South Carolina Wildlife Federation. Plans for leaving a 300-ft buffer along the Make-Up Pond C shoreline are addressed in Section 4.3.1.2 of the EIS. Upon further evaluation of a maintained 50-ft buffer, the applicant has proposed "to allow a natural shoreline buffer and install a log boom in order to protect blockage of the [Make-Up] Pond C spillway" (Duke 2012e). Sections 3.3.1.8 and 5.3.1.1 of the EIS were modified as a result of the applicant's proposal.*

Comment: No discussion of mitigation of terrestrial habitats (outside of wetland and streams) is included in the referenced section of the DEIS, and Duke Energy has not had such discussions with SCDNR. The reference to a preliminary approach to compensatory mitigation of rare, unique, or otherwise valuable terrestrial habitats appears to misconstrue the Duke Energy response to RAIs 209 and 213 (Accession No. ML102850208). This response indicates that in discussions with SCDNR concerning compensatory mitigation for wetlands and streams, Duke Energy has reviewed impacted habitats at Make-Up Pond C. Compensatory mitigation plans for wetlands and streams may involve tracts of land that benefit communities discussed in the DEIS; however, this benefit is not part of compensatory mitigation for those communities. The response to RAIs 209 and 213 is not included as a reference in the DEIS. Note that in section 4.3.1.6, the cited reference, Duke 2010o, does not appear to discuss mitigation for wetlands, streams, or terrestrial systems. The citation should be to ML102850208. (**0134-36** [Fallon, Chris])

Response: *EIS Section 4.3.1.6, now Section 4.3.1.7, was revised to reflect the most recent information available on compensatory mitigation to replace the lost functions of London Creek and its riparian corridor on a watershed scale. Section 4.3.1.7 was clarified to state there would be no mitigation for upland habitats, but that some upland habitats may benefit by their inclusion as buffer areas in mitigation tracts for wetlands and streams. The revision included reference to RAIs 209 and 213 (Duke 2010b).*

E.2.8 Comments Concerning Aquatic Ecology

Comment: The other issue I want to bring up is my concerns about the Broad River and the cumulative effects of the thermal contamination. I didn't get an answer to my question about how many power plants are along the Broad River, but there are several, and then there's other industries and things that are dumping heat into the river. I don't think there's any way that this cannot affect the ecosystem of the river... (**0012-15-3** [Larsen Clark, Brita])

Comment: Discharges of hot water, heavy metals and possibly traces of radiation could place stress on the aquatic community... (**0012-7-11** [Hicks, Katie])

Comment: After use the water that is used is returned to the river as thermal pollution, which stresses fish, other animals living in the area, and the surrounding environment. (**0013-20-3** [Craig, Anne])

Comment: After use, water is returned to the river as thermal pollution which stresses fish, other animals living in the area and the surrounding environment. (**0095-4** [Craig, Anne])

Response: *The Lee Nuclear Plant will use closed-cycle cooling, which substantially reduces the thermal discharge to the receiving waters. Detectable impacts to aquatic resources from the thermal discharge are not expected. Thermal impacts to the aquatic environment from operating the Lee Nuclear Station are addressed in Section 5.3.2 of the EIS. No changes to the EIS were made as a result of these comments.*

Comment: After use, water is returned to the river as "thermal pollution" (warm water) which stresses fish, other animals living in the area and negatively impacts the surrounding environment. The SC Dept of Natural Resources list the Carolina Fantail Darter fish that lives in the Broad River as "critically imperiled" in South Carolina & warns of "high conservation priority." (**0017-6** [Morgan, Tom and Barbara])

Comment: After use, water is returned to the river as "thermal pollution"(warm water) which stresses fish, other animals living in the area and negatively impacts the surrounding environment. The SC Dept of Natural Resources list the Carolina Fantail Darter fish that lives in the Broad River as "critically imperiled" in South Carolina & warns of "high conservation priority". I don't believe we can continue to rely on the Broad River and its natural populations to support even more cooling capacity! (**0048-5** [Skeele, Michele and Skip])

Comment: [If Lee Nuclear Station is built:] Broad River & the Carolina Fantail Darter fish would be threatened. (**0114-5** [Lovinsohn, Ruth])

Response: *Section 5.3.2.3 of the EIS addresses operational impacts, including those from thermal discharge, on the Carolina Fantail Darter* (Etheostoma brevispinum)*. No changes were made to the EIS as a result of these comments.*

Comment: The pond's creation would also result in complete loss of rare and valuable Piedmont riparian habitat along London Creek. (**0012-7-6** [Hicks, Katie])

Comment: London Creek [Section 2.4.2.1 Aquatic Resources - Site and Vicinity]
If permitted, Make-Up Pond C, at 632 acres, would be the largest reservoir permitted in the state of South Carolina since Lake Russell. The proposed flooding of more than 6 miles of stream will require mitigation for unavoidable impacts to Waters of the United States. In order to adequately mitigate all identified impacts, the Licensee will be required to develop a comprehensive mitigation plan. For impacts to the amount of wetlands and stream that will be involved to develop Make-Up Pond C, such a mitigation plan should encompass more than simple wetland and stream impact restoration and compensation. DNR requests continued discussion with the Licensee and resource agencies regarding appropriate compensatory mitigation to replace the lost functions of London Creek and its riparian corridor on a watershed scale. (**0126-14** [Vejdani, Vivianne])

Comment: 4.1.2 The Make-Up Pond C Site: See comments in section 2.4.2.1 Aquatic Resources -Site and Vicinity. (**0126-34** [Vejdani, Vivianne])

Response: *The loss of riparian habitat along London Creek is described in Sections 4.3.1 and 4.3.2 of the EIS. Unavoidable impacts to wetlands and streams would be mitigated through compensatory mitigation. Duke has consulted with the USACE to develop a compensatory mitigation plan in conformance with the requirements of USACE Charleston, South Carolina District* Guidelines for Preparing a Compensatory Mitigation Plan *(USACE 2010) and* Compensatory Mitigation for Losses of Aquatic Resources; Final Rule *(73 FR 19594, 40 CFR Part 230 and 33 CFR Part 332). A summary of Duke's compensatory mitigation plan is included in Section 4.3.1.7 (formerly Section 4.3.1.6) of the EIS.*

Comment: So I spoke to South Carolina naturalist Pat McMillan, who's on TV, who states that the endangered plant species called the rocky shoals spider lily will be negatively impacted. And why? Because of the water flow fluctuations and the water quantities available in the Broad River downstream. Also endangered is the Carolina fantail darter fish. (**0012-4-2** [Conard, Sky])

Comment: The region's citizens and our governing agencies who do water supply planning need to strongly reject this flawed proposal that would 1) severely diminish the public basin's water supply, 2) forever alter this watershed's course and its ecosystem. (I spoke to South Carolina naturalist Pat McMillan who states that the endangered plant species called Rocky Shoals Spider Lily will be negatively impacted because of water flow fluctuation and water quantities. Also endangered is the Carolina Fantail Darter fish.) (**0094-2** [Conard, Sky])

Response: *The rocky shoals spider lily* (Hymenocallis coronaria) *is State-ranked S2, imperiled in South Carolina. Based on field surveys, this species is not known to occur in the vicinity of the proposed Lee Nuclear Station site. The nearest known occurrence of this species in the Broad River is at Lockhart Dam (SCDNR 2012b), approximately 22 mi downstream of the Lee Nuclear Station discharge structure to be located on the upstream side of Ninety-Nine Islands Dam. The FERC minimum flow requirements for the Broad River at the Ninety-Nine Islands Dam will not be altered as a result of the Lee Nuclear Station; therefore, operations at the Lee Nuclear Station would not affect the rocky shoals spider lily. Operational impacts to the State-ranked Carolina Fantail Darter* (Etheostoma brevispinum) *are described in Section 5.3.2.3 of the EIS. No changes were made to the EIS as a result of these comments.*

Comment: [The following problems are among those we have identified:] The need to re-dredge reservoirs for backup cooling water such as Ponds A and B, plus newly digging 640-acre Pond C. (**0119-5** [Thomas, Ruth])

Response: *Localized dredging within Make-Up Ponds A and B is required to improve water movement and is discussed in Sections 3.3.1.6 and 3.3.1.7 of the EIS, respectively. Dredging impacts to aquatic resources within Make-Up Ponds A and B are discussed in Section 4.3.2 of the EIS. As described in Section 3.3.1.8 of the EIS, creation of Make-Up Pond C requires clearing land, excavation activities, and building a dam and other water-retaining structures to impound London Creek; no dredging is required. No changes to the EIS were made as a result of this comment.*

Comment: 2.4.2.1 Aquatic Resources -Site and Vicinity
Broad River and Ninety-Nine Islands Reservoir

This section of the DEIS discusses the provision for fish passage facilities at 7 hydroelectric projects on the Broad River under the Santee River Basin Accord for Diadromous Fish Protection, Restoration, and Enhancement of 2008. The Ninety-Nine Islands Project is fourth in line for the installation of fish passage facilities if efforts to pass anadromous fish species such as American shad and blueback herring (*Alosa aestivalis*) are successful. DNR recommends confirmation that the proposed intake and diffuser structures would not conflict with the footprint of a fish passage facility at the Ninety-Nine Islands Dam, should one be constructed in the future. (**0126-12** [Vejdani, Vivianne])

Comment: 4.3.1.2 Terrestrial Resources -The Make-Up Pond C Site See comments in Section 2.4.2.1 Aquatic Resources -Site and Vicinity. (**0126-31** [Vejdani, Vivianne])

Response: *This recommendation from the SCDNR is directed to Duke; however, Article 405 of the FERC license for the Ninety-Nine Islands Project (FERC No. 2331-002), issued June 17, 1996, reserves the FERC's authority "to require the licensee to construct, operate, and maintain, or provide for the construction, operation, and maintenance of, such fishways as may be* *prescribed by the Secretary of Interior" (PNNL 2011). No changes were made to the EIS as a result of these comments.*

Comment: Section 2.4.2.1, Page 2-96, Figure 2-18: Add Station number 465 to figure just below Cherokee Falls Dam; Table 2-10: Change Station number 459 to 458 in header row of table. (**0134-8** [Fallon, Chris])

Response: *Station 465 has been added to Figure 2-18 just below Cherokee Falls Dam. Station 459, a macroinvertebrate sampling location in the impoundment on west side of main channel (near proposed cooling-water discharge), has also been added to Figure 2-18 and is the correct station number in the header row of Table 2-10. Station 458 remains on Figure 2-18 because it identifies a fishery sampling location. Stations 465 and 459 were also added to the text in EIS Section 2.4.2.1.*

Comment: Section 2.4.2.3, Page 2-112, Line 16: This sentence refers to the number collected by electro-fishing, but 262 quillbacks were collected by gillnetting in Ninety-Nine Islands Reservoir in 2006, as referenced in Fishery Resources Associated with the Lee Nuclear Station Site; Cherokee County, South Carolina (Barwick et.al., 2006). This reference was provided to the NRC in response to RAI 53, dated September 17, 2008. (See also, Section 4.3.2.3, Page 4-62, Line 15) (**0134-10** [Fallon, Chris])

Response: *Commenter is correct. Appropriate revisions were made to Sections 2.4.2.3 and 4.3.2.3 of the EIS.*

Comment: Section 4.3.2.3, Pages 4-61, Line 26: The Carolina Heelsplitter account was included within the account of the Carolina Fantail Darter and this appears to be an error. Both, however, are ranked as S1 although the Carolina Heelsplitter has not been documented in the project area. (**0134-44** [Fallon, Chris])

Response: *Commenter is correct. The Carolina heelsplitter* (Lasmigona decorata) *descriptive information has been removed from the Carolina Fantail Darter description in Section 4.3.2.3 of the EIS.*

Comment: Section 4.3.2.5, Page 4-63, Lines 26-27: Not all aquatic resources would be lost. Some resources would remain, including those species that could adapt to lentic environments or migrate to upstream reaches of the tributaries that are not impounded. Additionally, certain aquatic functions of London Creek would remain such as flood attenuation and water quality treatment. (**0134-45** [Fallon, Chris])

Response: *Commenter is correct. With the possible exception of a segment approximately 0.6 mi in length between the Make-Up Pond C dam and the confluence with the Broad River, the main stem of London Creek would be inundated and the resulting Make-Up Pond C* *impoundment would replace a lotic (flowing water) system with a lentic (still water) system. Some aquatic functions would remain, in particular, flood attenuation and water quality and some aquatic species (e.g., sunfish) could adapt to the lentic environment. In addition, some of the upper reaches of tributaries to London Creek not impounded would retain their lotic characteristics; however, they would become isolated from other lotic habitat. Section 4.3.2.5 (now Section 4.3.2.4) of the EIS was revised to address this comment.*

Comment: Section 2.4.2.3, Pages 2-108 through 2-112: The NRC should conduct a global correction for the reference (Jenkins and Burkhead 1993). The correct year of publication is 1994. (**0134-9** [Fallon, Chris])

Response: *The NRC staff acknowledges that although the book was published in 1994, the editor of the book states the correct date for referencing is actually 1993. No changes were made to the EIS as a result of this comment.*

Comment: Section 5.3.2.3., Page 5-36, Lines 34 to Page 5-37, Lines 1-2: The DEIS indicates that consumptive water use is 5%. This percentage should actually be 3% based upon the NPDES Permit Application. (**0134-53** [Fallon, Chris])

Response: *The commenter is correct. The text was revised to state the consumptive water use is 3% of the mean annual flow.*

Comment: Section 7.3.2, Page 7-32, Lines 12-13: As stated in Section 5.3.1.1 of the DEIS and 5.2.1.6 of the ER, periodic dredging around the intakes will be required. Dredging is not anticipated to be performed annually. (**0134-63** [Fallon, Chris])

Response: *Section 7.3.2 of the EIS was revised to state that periodic dredging would be required at the Broad River intake structure.*

Comment: Section 7.3.2, Page 7-34, Lines 36-37: Change, "...Duke has committed to use water stored in Make-Up Ponds B and C as cooling water for the reactors to maintain the necessary water flows in the Broad River" to state, "...Duke has committed to use water stored in Make-Up Ponds B and C as cooling water for the condensers to maintain the necessary water flows in the Broad River" for clarification. (**0134-64** [Fallon, Chris])

Response: *Section 7.3.2 of the EIS was modified to incorporate the recommended clarification. The sentence now states "…Duke has committed to use water stored in Make-Up Ponds B and C as cooling water for the condensers to maintain the necessary water flows in the Broad River (Duke 2009b)."*

Comment: Section 7.3.2, Page 7-27, Lines 35-38, and 7-28, Lines 1-5: It is important to note that although the transmission lines will span these stream systems and limited clearing of canopy trees will be performed for conductor clearances, no Clean Water Act Section 404 impacts will occur to the jurisdictional resources (refer to the Section 404 permit application submitted November 2011). (**0134-62** [Fallon, Chris])

Response: *Volume I of the* William S. Lee III Nuclear Station Joint Application for Activities Affecting Waters of the United States *(Duke 2011c) states, "No impacts to tributaries will occur within the offsite transmission line permit area components, as the transmission lines will span these jurisdictional features and transmission structures will be located within the uplands. Hand cutting of canopy trees will occur within tributary buffers." Sections 4.3.1, 4.3.2, and 7.3.2 of the EIS were modified as a result of this comment.*

Comment: Section 5.3.2.3, Page 5-36, Line 20: Define "state-ranked species". See prior Comment #35 under Chapter 4.0. (**0134-52** [Fallon, Chris])

Response: *State ranking (in addition to the Federal listing) provides the only common basis for comparison of numbers of important animal and plant species between the proposed Lee Nuclear Station site, located in South Carolina; the Keowee and Middleton Shoals alternative sites, also located in South Carolina; and the Perkins alternative site, located in North Carolina. The staff considered, as part of its evaluation, species ranked as critically imperiled (S1), imperiled (S2), or vulnerable (S3) by the State of South Carolina, some of which have also been assigned a State-protection status of threatened or endangered. The term "State species of concern" was not used in the EIS because it is not an official designation for South Carolina (SCDNR 2011) and was not used by the SCDNR in the source documents referenced in the EIS. For clarity, the introductory portion of Section 2.4 was revised to include more detailed definitions.*

Comment: Section 4.3.2.1, Page 4-56, Lines 6-7: Eastern floater is not a species of high conservation priority according to the cited reference. This species is not mentioned in the cited reference (SCDNR 2005). This species has a conservation status ranking of G5/SNR (globally secure, state not ranked). Reference citation appears in the wrong location within the sentence. (**0134-43** [Fallon, Chris])

Response: *The commenter is correct; the Eastern floater* (Pyganodon cataracta) *is not a priority species for the South Carolina State Comprehensive Wildlife Conservation Strategy (SCDNR 2005). References to the Eastern floater as a priority species were deleted from Table 2-14; Section 4.3.2.1, and Section 4.3.2.3 of the EIS.*

Comment: Section 9.3.3.4, Page 9-74, Lines 27-30: The DEIS states: "Operation of new facilities at the Perkins Site would require three new supplemental cooling-water reservoirs (totaling 1500 ac with approximately 33,000 ac-ft of storage)... (Duke 2009c)." This cooling water reservoir storage volume was provided in the response to RAIs 127 and 131. Therefore, the reference should be Duke 2010g. (**0134-73** [Fallon, Chris])

Response: *The commenter is partially correct. In Section 9.3.3.4 of the EIS, the reference for the acreage of the cooling-water reservoir should be the response to RAIs 127 and 131, whereas the reference for the storage volume of the cooling-water reservoir should be the response to RAI 206. Section 9.3.3.4 of the EIS was updated with the correct references. In addition, Sections 9.3.4.4 and 9.3.5.4 were updated with the correct reference for the cooling-water reservoir storage volume.*

Comment: Lake Cherokee: Lake Cherokee is public property owned by the State of South Carolina, and DNR maintains the use of that lake to provide recreational fishing opportunities to the public. SC Wildlife Federation recommends that the public recreational opportunities in and around the lake not be adversely affected, especially during major flood events. The applicant should work very closely with SC DNR to ensure there will be no adverse effect on the public use of the Lake Cherokee resource. (**0135-4** [Gregg, Ben])

Response: *These recommendations by the South Carolina Wildlife Federation are directed to Duke, therefore no changes were made to the EIS.*

Comment: Measures to limit bioentrainment and other impacts to aquatic species from surface water withdrawals and discharges should be referenced in the FEIS, and should continue to be addressed as the project progresses, in compliance with the NPDES Permit.
(**0142-16** [Mueller, Heinz])

Response: *Measures to limit bioentrainment and other impacts to aquatic species from surface water withdrawals and discharges are discussed in Section 5.3.2.1 of the EIS. The EPA and its delegated States, not the NRC, regulate entrainment and impingement as well as the effects of surface water discharges under the CWA through NPDES permits. The NRC discloses such impacts in the EISs it prepares under NEPA, but does not regulate the impacts. The EPA has delegated the authority for administering the NPDES program in South Carolina to the SCDHEC. On July 17, 2013, the SCDHEC issued NPDES Permit No. SC0049140 to Duke for the Lee Nuclear Station (SCDHEC 2013). This permit includes requirements for both biological monitoring and velocity monitoring at the cooling water intake structure. In addition, Duke shall not operate the drought contingency section of the river intake during the months of March, April, May, or June.*

Comment: Chronic and Cumulative Impacts
The applicant has proposed damming of the London Creek watershed to create Make-Up Pond C. The proposed intention of this pond is to provide additional water to both Make-Up Ponds A and B during low flow conditions and prolonged drought. The proposed work would impound 6 miles of London Creek to create a 620-acre reservoir.

London Creek is a headwater Piedmont stream with bedrock, cobble, and coarse substrates, sinuosity, riffle/pool habitat, leaf packs and woody debris. The dominant source of energy for production in southeastern rivers is the terrestrially derived plant and organic material that is collected, processed, and exported downstream by headwater streams (Minshall et al. 1983, Webster et al. 1995). Detrital resources provide a primary energy source for macro-invertebrate production including aquatic insects, which supplies the food base for upper trophic levels (Freeman 2005). Hydroelectric projects throughout the Broad River basin have disproportionately eliminated and cumulatively affected riffle and shoal habitats, including headwater stream habitats. The creation of Make-Up Pond C would cause irreparable and irretrievable loss of Piedmont stream habitat and the species whose life cycles depend on those habitats.

Surveys conducted in London Creek collected 22 fish species. One species, the greenhead shiner, *Notropis chiorocephalus*, is a South Carolina State Conservation species of "High Priority" and three additional species of "Moderate" priority including the greenfin shiner, *Cyprinella chioristia*, highback chub, and flat bullhead, were collected. These species would not survive the complete inundation of stream habitat to create a large reservoir habitat. This would result in the direct loss of these species, whose populations are already in decline.
(**0141-7** [Caldwell, Mark] [Stanley, Joyce A.])

Response: *The NRC staff appreciates the review and synopsis that the FWS provided in this comment related to information presented in Sections 2.4.2.1 and 4.3.2.1 of the draft EIS. With the possible exception of a segment approximately 0.6 mi in length between the Make-Up Pond C dam and the confluence with the Broad River, the main stem of London Creek and unnamed tributaries would be inundated and the resulting Make-Up Pond C impoundment would replace a lotic system with a lentic system. The NRC staff acknowledges that there would be irreparable and irretrievable loss of Piedmont stream habitat and individuals of the fish species that cannot adapt to the lentic environment. Downstream from the proposed Make-Up Pond C impoundment, Duke has proposed minimum seasonal flow releases to maintain existing water uses and to protect the remaining aquatic community of London Creek* (*Duke 2012f). The discussion of aquatic resource impacts from Make-Up Pond C in Section 4.3.2 has been expanded to reflect this comment.*

Comment: Fish [Section 2.4.2.1 Aquatic Resources - Site and Vicinity]
2000s DNR staff sampled the upper portion of the Ninety-Nine Islands Reservoir and a site 4.5 km below the dam while completing the Broad River Aquatic Resources Inventory (Bettinger, Crane and Bulak, 2003). State conservation priority species collected include seagreen darter (*Etheostoma thalassinum*), piedmont darter (*Percina crassa*), quillback (*Carpiodes cyprinus*), greenfin shiner (Cyprinella chloristia), fieryblack shiner (Cyprinella pyrrhomelas), notchlip redhorse (*Moxostoma collapsum*), V-lip redhorse (*Moxostoma pappillosum*), snail bullhead (*Ameiurus brunneus*) and flat bullhead (*Ameiurus platycephalus*). Important recreational fisheries include largemouth bass (*Micropterus salmoides*) smallmouth bass (*Micropterus dolomieu*) and black crappie (*Pomoxis nigromaculatus*). Although sampling

results indicated that the condition of the largemouth bass population was good, largemouth bass condition near sites of industrial effluent were adversely affected. Carolina darter (*Etheostoma collis*), fantail darter (*Etheostoma flabellare*) and highback chub (*Hybopsis hypsinotus*) are known state conservation priority fish species from the Kings Creek system, which drains into the Broad River below Ninety-Nine Islands Reservoir and therefore could be affected by activities at the Lee Nuclear Station. The Broad River below Ninety-Nine Islands Reservoir also supports an excellent smallmouth bass fishery that is enjoyed by South Carolina anglers as well as anglers from surrounding states. The fishery is augmented with supplemental stockings, but the majority of fish are wild spawned. Smallmouth bass grow rapidly and reach large sizes in the Broad River giving anglers the opportunity to catch trophy fish. (**0126-13** [Vejdani, Vivianne])

Response: *The NRC staff appreciates the review and synopsis that the SCDNR provided in these comments related to the information provided in Section 2.4.2.1 of the draft EIS. A subsequent e-mail from Vivianne Vejdani, SCDNR, to Nancy Kuntzleman, NRC, dated April 5, 2012, clarified that the Carolina Fantail Darter* (Etheostoma brevispinum)*, not the Carolina Darter* (Etheostoma collis)*, was found in the Kings Creek drainage (SCDNR 2012c). No changes to the EIS were made as a result of these comments.*

Comment: The NRC fails to fully analyze the following potential impacts of elevated water temperatures in the Broad River and its water shed: The impact of the reactors thermal discharge (warmed water) on water that is already elevated in temperature, looking at both additive and synergistic impacts on the local and down-river ecosystem.
(**0130-3** [Zeller, Lou])

Response: *Thermal impacts to the aquatic environment from operating the Lee Nuclear Station are addressed in Section 5.3.2 of the EIS. The review team's evaluation of the cumulative impacts of past, present, and reasonably foreseeable future thermal discharges in the Broad River basin is discussed in Chapter 7 of the EIS. No changes to the EIS were made as a result of this comment.*

Comment: In review of the DEIS, the Service has several concerns pertaining to adverse impacts to aquatic communities of the Ninety-Nine Islands reservoir, the Broad River downstream of the dam, and the London Creek watershed. These concerns include the direct and cumulative effects from consumptive water loss from Units 1 and 2, evaporative loss from ponds, aquatic effluent discharge from cooling tower blowdown, and the loss of aquatic habitat and species from the damming of London Creek. (**0141-1** [Caldwell, Mark] [Stanley, Joyce A.])

Response: *This comment from the FWS expresses concerns pertaining to adverse impacts to aquatic communities. The effects of construction (damming London Creek), operation (water consumption and effluent discharge), and cumulative impacts on aquatic resources are* *discussed in Chapters 4.3.2, 5.3.2, and 7.3.2 of the EIS, respectively. No changes to the EIS were made as a result of this comment.*

Comment: The Broad River sub-basin has been designated within the Santee River Basin Accord as the primary sub-basin, within the Santee River system, for restoration of diadromous fish. The Service is concerned with the potential impacts to restoration activities from the proposed discharge effluent, particularly the recruitment and survivability of diadromous fish larvae and out-migrating juveniles, and the catadromous American eel. A thermal discharge into Ninety-Nine Islands reservoir, and into the Broad River, may compromise ongoing restoration efforts for both anadromous and catadromous fishes, as well as rare freshwater species including the robust redhorse sucker, freshwater mussels, snails, and crayfish. It should be noted that the robust redhorse sucker, which has been stocked in the Broad River by the South Carolina Department of Natural Resources is currently under a Federal 90-day Petition Finding for Listing under the Endangered Species Act.

According to the DEIS, fish surveys were conducted in 2006 in the Ninety-Nine Islands reservoir, its tailrace, and in the Broad River below the darn. In the reservoir, including its backwaters, two of the species collected were South Carolina State Conservation species of "High Priority" including the quillback, *Carpoides cyprinus*, and Carolina fantail darter, *Etheostoma brevispinum*. Additionally, two species of "Moderate" priority, the V-lip redhorse, *Moxostoma pappillosum*, and the Notchlip redhorse, *Moxostoma collapsum*, were also collected. Below the Ninety-Nine Island Dam, surveys collected the Quillback (High Priority). Seven species of "Moderate" priority were collected including the Fieryblack shiner, *Cyprinella pyrrhomelas*, Thicklip chub, *Hybopsis labrosa*, Greenfin shiner, *Notropis chloristius*, V-lip redhorse, flat bullhead, *Ameiurus platycephalus*, highback chub, *Hybopsis hypsinotus*, and the Snail bullhead, *Ameiurus brunneus*. In 2003-2004, the DEIS published that fish surveys conducted below the Ninety-Nine Island Dam collected the Santee chub, *Hybosis zanema*, which is also a species designated as "High Priority."

Freshwater mussel surveys below Ninety-Nine Island Dam collected four species of "Moderate Priority" including the Eastern elliptio, *Elliptio complanata*, Eastern creekshell, *Villosa delumbis*, yellow lance, *Elliptio lanceolata*, and Carolina lance, *Elliptio angustata*. It should be noted that the yellow lance is currently under a Federal 90-day Petition Finding for listing under the Endangered Species Act.

The Service recommends that a more intensive survey for freshwater mussels be conducted downstream of the Ninety-Nine Islands Dam. We also recommend a survey for freshwater snails be conducted along with the mussel survey, because the DEIS does not contain information regarding gastropod surveys in the Broad River, the reservoir, or London Creek and its tributaries. (**0141-4** [Caldwell, Mark] [Stanley, Joyce A.])

Comment: Based on the Service's review of the DEIS, we believe additional information is required to provide a complete analysis of the effects of the proposed project on fish and wildlife resources. We recommend the following:

1) A survey for snails be conducted in London Creek and its tributaries, and downstream of the Ninety-Nine Island Dam in the Broad River.

2) A comprehensive survey for the yellow lance below the dam in the Broad River, and downstream areas affected by the discharge from the hydroelectric project, because the mussel is currently under a 90-Day Petition Finding for listing under the Endangered Species Act. (**0141-8** [Caldwell, Mark] [Stanley, Joyce A.])

Response: *The NRC review team recognizes the efforts made by the Federal- and State-resource agencies and utility companies to restore diadromous fishery resources in the Santee-Cooper River basin with the completion of the Columbia Dam fishway in 2006 and the signing of the Santee River Basin Accord in 2008. If diadromous species [e.g., American Shad (*Alosa sapidissima*) and American Eel (*Anguilla rostrata*), the only diadromous species with a historical presence in the vicinity of the Lee Nuclear Station] eventually become re-established below Ninety-Nine Islands Dam, it is unlikely that the discharge effluent from the Lee Nuclear Station would impede their upstream/downstream migration in the Broad River. The small area of increased temperatures would limit the extent of any impact and would not result in a thermal blockage. Section 5.3.2 of the EIS discusses the potential impacts to aquatic resources, including diadromous fish species, from the Lee Nuclear Station blowdown and wastewater-discharge system. A discussion of potential impacts to species of ecological significance, including South Carolina priority conservation species, was added to Section 5.3.2.3 of the EIS.*

The NRC staff acknowledges the comments provided by the FWS concerning the Federal 90-Day Petition Finding for Listing under the Endangered Species Act and recommendations for more intensive freshwater mussel and snail surveys downstream of Ninety-Nine Islands Dam. The NRC, under NEPA, cannot require monitoring. If any of these species achieve protected status, the NRC staff will consider re-initiating consultation with the FWS if there is potential for impacts to these species due to operations at the Lee Nuclear Station. No changes have been made to the EIS as a result of these comments.

Comment: The Service is especially concerned with the effects of the proposed cooling tower blowdown discharge on the aquatic community and ecosystem of the Ninety-Nine Islands Reservoir and the Broad River downstream of the dam. The blowdown discharge would contain biocides, chemical additives, radioactive waste, and thermal effluent. The chronic and cumulative effect of chemicals and radioactive waste would adversely affect fish and invertebrate spawning and recruitment in the vicinity of the discharge within the reservoir, and downstream of the dam, particularly during periods of low flow. The thermal effluent would affect fish and invertebrate spawning, and biological systems through stress and/or direct mortality. It would especially affect non-motile or slow moving invertebrates such as freshwater mussels and other aquatic invertebrates. (**0141-5** [Caldwell, Mark] [Stanley, Joyce A.])

Response: *Pursuant to the CWA, the EPA has the authority to require water-quality monitoring for physical and/or chemical parameters in the waters of the United States. In South Carolina, the EPA delegates this authority to the SCDHEC. On July 17, 2013, the SCDHEC issued NPDES Permit No. SC0049140 to Duke for the Lee Nuclear Station (SCDHEC 2013). This permit includes requirements for effluent limitations and monitoring, chronic toxicity testing, implementation of best management practices to control spills of oils and hazardous or toxic substances, and conducting confirmatory sampling of the computational fluid dynamics modeling used to support the thermal and toxicity mixing zone requests.*

Comment: [Based on the Service's review of the DEIS, we believe additional information is required to provide a complete analysis of the proposed project on fish and wildlife resources. We recommend the following:]

3) The applicant should develop and implement a plan to collect the South Carolina State Conservation High and Moderate priority fish species in London Creek and relocate to nearby suitable streams prior to construction of Pond C. (**0141-9** [Caldwell, Mark] [Stanley, Joyce A.])

Response: *This recommendation by the FWS to develop and implement a fish relocation plan for the South Carolina State Conservation High and Moderate Priority fish species is directed to the applicant. The NRC, under NEPA, cannot require fish relocation. No changes were made to the EIS as a result of this comment.*

Comment: EPA reviewed the Joint Public Notice (JPN) and submitted comments regarding the compensatory mitigation and permit action under separate cover to Lt. Colonel Edward P. Chamberlayne, USACE on March 6, 2012 (enclosed). This letter states that "The EPA has significant concerns that the effect of conversion of this stream into an impoundment could result in the elimination of existing uses of the streams in and downstream of the area of the proposed project, including the segments of the streams that could become the tailrace waters of the reservoirs during and after impoundment. The conversion may also require a change in the designated uses that are currently assigned to these streams in South Carolina water quality standards. Prior to the conversion, it must be demonstrated that such a conversion complies with all aspects and requirements of South Carolina's antidegradation policy, as well as any other applicable provision of South Carolina's water quality standards regulation." (**0142-11** [Mueller, Heinz])

Response: *Any changes to current designated water uses resulting from the impoundment of London Creek will require approval of the State. The State (SCDHEC), not the NRC, will address the issue of designated water uses for London Creek and its tributaries. However,* *Duke has stated it will not eliminate existing uses of streams in and downstream of the proposed project after impoundment (Duke 2012f). No changes were made to the EIS as a result of this comment.*

Comment: 2.4.2.4. Aquatic Ecology Monitoring
Of particular importance to DNR is the assurance that the aquatic ecology of Ninety-Nine Islands Reservoir and the Broad River downstream of Ninety-Nine Islands Dam will not be adversely impacted by operations at the Lee Nuclear Station, particularly the smallmouth bass fishery, which is more sensitive to potential thermal impacts. DNR has reviewed the Mixing Zone Request prepared by Geosyntec on behalf of the Licensee in support of their National Pollutant Discharge Elimination System (NPDES) permit application, which includes a summary of the model used to characterize the thermal and chemical plume. DNR notes that only the normal operations discharge of 18 cfs was considered in model scenarios. The maximum discharge of 64 cfs was not considered as a model scenario. During the interagency meeting held on February 17, 2012, DNR was assured by the Licensee that maximum discharge events would occur only during high flow periods. DNR requests additional information on the duration and magnitude of maximum blowdown discharge events. We are particularly interested in the extent of the thermal plume below the dam during maximum discharge. DNR urges due diligence by the South Carolina Department of Health and Environmental Control (DHEC) to ensure that the NPDES permit for the Lee Nuclear Station will be conditioned to require appropriate biological and chemical monitoring, to include fish community monitoring, before and after commencement of operations. (**0126-15** [Vejdani, Vivianne])

Response: *Maximum blowdown discharge could occur if the circulating-water-system's cooling-water towers were to operate at two cycles of concentration instead of the normal four cycles. Two-cycle operation would be implemented to control high levels of total suspended solids (TSS) in the Broad River, which would occur after significant rainfall in the watershed (and hence when flows would be higher). Because water withdrawn from the Broad River is stored in Make-Up Pond A before being used by the recirculating cooling-water towers, settling processes in the pond are expected to limit and moderate TSS excursions. Duke anticipates that operating at two cycles of concentration would be a rare occurrence lasting less than 2 days, based on historical TSS data showing that there has been no occurrence of TSS conditions that would have required the cooling towers to operate at two cycles of concentration. The cooling system is also designed to achieve a maximum discharge temperature of 91°F during summer conditions of high ambient river and air temperatures and seasonally low flows (Duke 2011b). If the cooling system were operating at two cycles of concentration, the discharge temperature would likely be less than 91°F and the river flow would be higher than seasonally low flows.*

On July 17, 2013, SCDHEC issued NPDES Permit No. SC0049140 to Duke for the Lee Nuclear Station (SCDHEC 2013). The NPDES permit, effective September 1, 2013, requires Duke to *submit for SCDHEC's approval a plan for confirmatory monitoring (confirm the accuracy of the computational fluid dynamics modeling that was used to support the thermal and toxicity mixing zone requests) within one year of the effective date of the permit. As stated on page 31 of the NPDES permit:*

The plan shall address the following elements: temperature monitoring methods, locations, and schedule; summer conditions monitoring to verify >90°F temperature plume does not extend beyond #4 turbine inlet; winter conditions monitoring to verify >5°F temperature increase plume does not extend beyond #4 turbine inlet; and consideration of timing of monitoring so that modeled scenarios (i.e. river temperature, river flow, discharge volume, and discharge temperature) are captured to the extent practical.

Section 5.3.2.1 of the EIS was revised to include address these changes and in response to these comments.

E.2.9 Comments Concerning Socioeconomics

Comment: I would like to take a few minutes to talk about the community impact of having Duke Energy Nuclear Station in your backyard. In York County we have Catawba Nuclear Station. The station's economic impact is great, and I don't believe anyone would argue that the money brought in by having a nuclear station in Cherokee County would benefit the county and the residents of that county. There are four benefits that I'd like to touch on briefly, if I could. One is jobs. Cherokee County, as of November, had 12 percent unemployment. The 4,000 jobs plus that would be available for construction and the 800 jobs for station operation would provide that 12 percent an opportunity to improve their lives and their families' lives. So we would support that effort. Economic impact. While there are those people living in Cherokee County who would acquire one of these construction or operation jobs, those funds would be available within the community to support other community activities. In addition to that economic impact, there would be millions of dollars that Duke would pay in property taxes that would go to improve schools and also cover operating expenses. Those dollars would also be available to the county to use for services for the needs of their community and the people of the community and also to retire debt. (**0012-14-1** [Boger, Paul])

Comment: As a chamber representative, I believe building this nuclear plant would be good for this region. The jobs, tax revenue and potential overall economic impact must be exciting to this community that has a need, as we all do. (**0012-14-3** [Boger, Paul])

Comment: While South Carolina certainly has its problems, we have many advantages for the attraction of business. One of the key advantages is the cost of electricity. Many of our new and expanding companies look for that in terms of their qualifications for bringing those new jobs to our community. Companies who use significant amounts of electricity are attracted, in fact, by the affordable power. We have one of the lowest power rates per kilowatt hour of any region in the nation. If we are to continue to compete globally, as somebody mentioned earlier, we're going to have to have additional capacity for electrical production, and this new unit will certainly help us maintain that advantage. In the last several years the Charlotte area has become a haven for nuclear engineering. Shaw, Areva, Mitsubishi, Toshiba and Fluor have all announced hundreds of new jobs, new high-paying jobs in the nuclear industry. The positive impact on York County schools has, again, made us one of the best school districts in the state and Charlotte region, and that makes it easier to do my job by creating higher technology companies to the area who seek better educated workers (**0012-16-1** [Farris, Mark])

Comment: What I will tell you that here in Cherokee County we're for this project, we think it will bring jobs. Jobs are important, believe it or not. We have a high unemployment rate, 12 percent right now, and with the construction of the Lee nuclear facility and the concurrent operation, we think it will be good for us job-wise. Economic development, it's my job, much like Mark's, to try to bring business and industry here to Cherokee County, and we know that this facility will help Duke Energy be able to provide those low rates that are vital. You've heard why they're important, why manufacturers want to go different places, and more and more energy costs are driving the train on that. (**0012-17-1** [Cook, Jim])

Comment: As a longtime resident of York County, I'm also here to offer personal testimony, much like Mark Farris did, as to the need and the benefits of a nuclear power station to a community. I respectfully request your thoughtful consideration of the following points. The Lee Nuclear Station will mean jobs. Unemployment rates in our region and in this state remain near record highs and at crisis levels, and jobs are desperately needed. These jobs, many well-paying, will be created in the construction of the Lee Station, and employees with diversified skills will be necessary to operate and maintain the plant. The station will mean economic development. Businesses and industries need reliable and affordable sources of energy. Communities need businesses to provide jobs and tax base. This tax base funds the operation of public schools and other necessary government services, plus the community's quality of life is also influenced by this tax base. This project will not only improve the service and increase the energy capacity of existing businesses in the region, it will also help lure additional businesses and jobs to the area and will provide commerce also for vendor and supplier businesses. Duke Energy, the station's operator, has a good record of providing support to and for local and state economic development efforts. (**0012-18-2** [Youngblood, Rob])

Comment: Additionally, Lee Nuclear will help support economic development in the region with potential for thousands of construction jobs and 800 to 1,000 well- paying, full-time jobs during station operation. It will also create other jobs in the local area to supply the needed goods and services and support of the work force. We have worked on development activities for Lee Nuclear. We've engaged local residents to evaluate ways to address potential traffic issues. (**0012-2-2** [Jamil, Dhiaa])

Comment: The construction of the new nuclear station also has an economic benefit for our state. Two thousand South Carolinians will be employed during the construction process, in addition to an estimated 700 full-time workers, not to mention the spinoff that we'll receive from local businesses that will receive income and support from the jobs created around the facility. South Carolina's research universities are focusing on hydrogen research for the automotive industry, and it relates directly to the nuclear energy and particularly nuclear plants as clean energy for South Carolina and the nation, creating a new segment for our economy. (**0012-5-4** [Rawl, Otis])

Comment: I think we all agree that conservation is the cornerstone of protecting South Carolina's natural resources, but throughout the energy debate we also must realize that businesses are not the enemy. The key is striking a healthy balance, one that protects our national resources without stifling needed economic development that creates jobs and prosperity for our citizens. As we continue to focus on economic development and creating jobs, we must not lose sight of the fact that one of the determining factors for businesses considering locating or expanding in our state is low cost, efficient and reliable energy. The nuclear facility in Cherokee County would bring billions of dollars of investment to our state, create thousands of jobs for our citizens, produce reliable energy for our businesses, and most importantly, do it in a carbon- free emission way. (**0012-5-5** [Rawl, Otis])

Comment: We are very quickly losing our competitive edge in this country with nations in other parts of the world that 20 or so short years ago we didn't think about. I visited China in 1986, and let me tell you, they were not an economic threat to this country at all, any way, shape or form. The Shanghai I visited in 1986 doesn't look anything like what it does today. They're eating our lunch, they are taking our jobs, but maybe, just maybe we're starting to see a few new words creep into our vernacular. The word restoring, the word expansion, the word plan, the word growth. Those are starting to come back and we'll only take advantage of them if we have built the kinds of facilities that Duke Energy is proposing here. It's absolutely important that we understand that these plants will be built. Make no mistake about it, there will be nuclear plants built in this world. They will be built in China and in India and in other places that understand that it's the key to prosperity and the key to bringing the jobs that my members provide. Let me say this as I close. We've let other situations like Fukushima, a silly movie from 30 years ago, and a few other things full of misinformation, and quite frankly, facts that just don't make sense keep us from pursuing a reasonable and responsible way of providing energy. Believe me, folks, if we let our manufacturing base continue to deteriorate, if we don't do what's necessary to encourage it, there are plenty of places in the world that will do it for us, and they will take those jobs and they will continue to take those jobs and they will have the prosperity that we once had. A lot of folks talk about how we are looking at the first generation in this country that might not do better than the previous generation. That's not necessarily going to happen, we don't have to accept that as our fate, but we've got to plant the seeds, we've got to have the ability to provide power to manufacturing facilities so that they can provide the jobs that are absolutely desperately needed in this part of South Carolina. (**0012-9-6** [Gossett, Lewis])

Comment: Whereas, nuclear power plants enhance South Carolina's economic competitive to producing electricity at stable prices, helping to retain existing industry, and to attract new business while also making a substantial economic contribution to the state in the form of significant capital investment, jobs, and tax base. (**0013-1-3** [Moss, Representative Dennis])

Comment: For the Environmental Impact Statement, first I'll talk about the economic development from the plant. There will be lots of well-paying jobs that will be created for the community during operation as well as during construction. On top of this it will be a boost to the economy to support these jobs for food for these people, for houses, for a number of other things they need every day. So the economy will be greatly benefitted in Gaffney due to this. There will be tax benefits to the community because the plant will be contributing to local taxes. And there will be a clean source of baseload energy to help keep energy prices down. Now, there's of lots of work that went into the Environmental Impact Statement. They spent number of hours making sure that it will be running safely. (**0013-17-2** [Reichenbach, Adam])

Comment: The -- we are in a recession right now -- the whole country is, including South Carolina. Our unemployment rate I've heard is around 10 percent here in South Carolina. We need jobs. Yes, someone's saying it's even higher than that. But bottom line is we need jobs. South Carolina's got good people. South Carolina's got a good work ethic. South Carolina has the capability to bring in companies to provide those jobs: BMW just down by Spartanburg, Boeing in Charleston, and many others throughout the country. What is it going to take to bring in more companies like that to bring in more jobs? It's going take energy. It's going to take electricity -- lots of electricity -- electricity that's reliable but operates 24 hours a day, seven days a week. Now, how can we do that? One is with nuclear like the Lee plant. (**0013-18-2** [Bromm, Bob])

Comment: We're pleased with the job growth it's going to bring us, the economic development, the tax base. (**0013-2-3** [Moss, Representative Steve])

Comment: The U.S. nuclear industry, including nuclear stations operated by Duke Energy, plays an important role in job creation and economic growth, generating substantial domestic economic value in electricity sales and revenues, along with jobs and economic development in the communities where the plants are located. (**0013-4-2** [Fallon, Chris])

Comment: A nuclear power plant will bring many desperately needed jobs to the area and a much needed source of clean energy. (**0054-3** [Gaddy, Ron])

Response: *These comments generally express support for the proposed Lee Nuclear Station based on the potential positive socioeconomic impacts such as new jobs, economic impacts, and increased property tax revenues it would be expected to bring to the region, as well as perceived low electricity prices. Socioeconomic impacts of building and operating the proposed Lee Nuclear Station are discussed in Sections 4.4 and 5.4 of the EIS. The NRC is not involved in developing energy policy for the United States, therefore issues related to energy prices and* *general economic global competitiveness are not considered in the EIS. No changes to the EIS were made as a result of these comments.*

Comment: I hear you on the demand for jobs. I'm looking for a job myself. But if your demand is for jobs I really think you're looking to the wrong place. A lot of these jobs are not going to be local -- these are going to be contracted out. (**0013-23-2** [Buscarino, John])

Comment: Please do not be lured by the promise of jobs. (**0013-35-1** [Hammett, Jan])

Comment: How can the argument that the construction of new nuclear plants would benefit our economic and underemployment crises, when the alternatives [alternative energies - wind, solar, etc.] identified above would be even more beneficial in these respects? (**0058-3** [Patrie, MD, MPH, Lewis E.])

Comment: And jobs. Dollar for dollar nukes are perhaps the most job-poor industry ever devised. The same money put into renewable energies would hire as much as twenty times more people. (**0100-6** [Richardson, Don])

Comment: The two plants expect to hire some 3,000 construction workers over several years and some 1,000 plant workers on a continuing basis. Jobs are needed in a depressed county, but remember that Hitler created jobs making death camps, too, so it is important to examine whether the jobs contribute to the long-term well being of the greater society. It is well documented that a given investment in energy efficiency and renewable energy sources creates more sustained employment than the same investment in nuclear energy, with a greater impact on the supply-demand balance. If the issues are jobs and need for power, then nuclear is the wrong objective to be pursued. (**0117-1** [Crissey, Brian])

Response: *Socioeconomic impacts, such as labor impacts associated with building and operating the proposed Lee Nuclear Station, are addressed in Sections 4.4 and 5.5 of the EIS. Socioeconomic issues related to alternative energy sources are addressed in Chapter 9. No changes to the EIS were made as a result of these comments.*

Comment: Section 2.5.1.1, Page 2-124, Figure 2-19: This figure shows the populations based on the 2000 census data presented in the ER Rev. 0, and does not reflect the 2007 census data presented in ER Rev. 1, referenced below the figure.
(**0134-11** [Fallon, Chris])

Response: *The figure referenced in this comment has been updated with the latest population data from the U.S. Census Bureau's American Community Survey.*

Comment: Section 9.3.3.5, Page 9-80, Line 8: The DEIS states: "No recreational facilities exist within the site boundary." Perkins State Game Lands are within the boundaries of one of the reservoirs. (**0134-75** [Fallon, Chris])

Response: *Section 9.3.3.5 of the EIS was updated to reflect that a portion of the Perkins State Game Lands is within the boundaries of the Perkins alternative site.*

Comment: Section 9.3.3.5, Page 9-82, Line 20: "Oconee County" should be changed to "Davie County." (**0134-76** [Fallon, Chris])

Response: *Section 9.3.3.5 was updated to reflect the change from Oconee County to Davie County.*

Comment: Section 9.3.3.5, Page 9-78, Lines 12-14: The DEIS states: "Based on the analysis of project impacts presented in Section 4.4.2, of the 4613 peak workers approximately 3151 workers would in-migrate into the region with some workers bringing a family for a total in-migrating population of 4516 people." The total in-migrating population of 3,151 represents the construction workers and does not include operations workers during the peak employment period. The value 3,151 should be changed to 3,191 to include the 40 in-migrating operations workers. The 4516 total in-migrating population includes these 40 in-migrating operations workers and their families. This number also should be corrected later in this section and in each corresponding section for the other two alternative sites. (**0134-74** [Fallon, Chris])

Response: *Sections 9.3.3.5, 9.3.4.5, and 9.3.5.5 were updated to reflect the total in-migrating workforce of 3191.*

Comment: I think the proposed Lee Nuclear Plant will effectively diminish the public use and resource rights of the Broad River. Is this powerful entity, Duke Energy, actually privatizing our public asset of water? I'm asking the question. It seems to me that this is a violation of environmental laws. (**0012-4-1** [Conard, Sky])

Response: *While the NRC does not regulate or manage water resources, it does have the responsibility under NEPA to assess and disclose the impacts of the proposed action on water resources and the public. The review team evaluated the impacts of building and operating the proposed Lee Nuclear Station Units 1 and 2 on local and regional water resources. Impacts on water resources related to construction and operation are presented in Sections 4.2 and 5.2. Recreational impacts were discussed in Sections 4.4 and 5.4. No changes were made to the EIS as a result of this comment.*

Comment: The environmental impact that we will have in Cherokee County outside of this plant, which seems to be well controlled by the Nuclear Regulatory Commission and Duke Power, is probably about 3,300 on average construction people are going to be in this county for a considerable amount of time. And these people are going to have families. So on average there may be three people per family. So that means 9,900 people -- almost 10,000 more people in this county. And it's going to impact on the housing, it's going to impact on government services, especially our schools because we're going to have a lot of young people. Also it's going to have more requirements for water and electricity. They're going to be building temporary trailer places there in the county, which is going to have an environmental impact from the standpoint of increased traffic on our highways and all that. Well, I'm sure that our government is going to do the best they can to try to alleviate those problems. But one thing the government -- one way they can alleviate which would be much better -- and I don't know if there's any government people from Cherokee County here or from the state -- but what they need to do is to accelerate training programs here in this county. They need to get Spartanburg Tech to get people over to our trade school over here in Gaffney which is going to be training people to operate this plant after it's built. What they need to do is to get them to increase the ability to train construction people. There's a lot of people that are construction in this county that have no employment because they're not building nothing. But they would be much better at doing the job for Duke Power and for us and provide help in making a safer facility if they have good training. And if the county and the state and Duke Power and hopefully with the Nuclear Regulatory Commission providing some assistance and organizing this training and getting it moving to where we have some well-trained people in this county to do the work. (**0013-34-1** [Beach, William])

Response: *Socioeconomic impacts, including impacts to public services, housing, traffic, and education related to building and operating the proposed Lee Nuclear Station are discussed in Sections 4.4 and 5.5. Hiring choices for the construction and operations labor force for the proposed Lee Nuclear Station are outside the scope of the NRC's regulatory authority. The NRC does license nuclear reactor operators; however, it does not provide training or organize education for nuclear industry personnel. No changes were made to the EIS as a result of this comment.*

Comment: [If Lee Nuclear Station is built:] Tourism would suffer. (**0114-8** [Lovinsohn, Ruth])

Response: *Tourism and recreational activities are discussed in Section 2.5. Recreational impacts from construction and operation of the Lee Nuclear Station are discussed in Sections 4.4 and 5.5. No changes were made to the EIS as a result of this comment.*

Comment: DNR staff met with representatives of the Licensee in August 2010 regarding DNR's concern about viewshed impacts from the transmission lines to the Scenic Broad River. During this meeting, Duke's representatives provided DNR staff a presentation depicting a simulation of the view-shed post construction as would be seen by recreationists utilizing the Broad River. Based on these depictions, DNR understands that the transmission lines will be minimally visible to the recreating public during winter leaf-off conditions. Furthermore, DNR understands that impacts can be further reduced through the employment of shorter towers along the Scenic Broad River corridor. DNR requested and was assured of continued consultation during the design phase of the transmission lines; however, as of this date, DNR has not received any such consultation. DNR urges the Licensee to avoid and minimize visual impacts to the greatest practicable extent through the careful design and placement of transmission lines (e.g., shorter towers and the use of wider buffer in those sections of the corridor along the Scenic Broad River). (**0126-18** [Vejdani, Vivianne])

Comment: Socioeconomics

We understand that the NRC cannot include mitigation measures in the license that do not pertain to nuclear security. However, EPA encourages the applicant to continue coordinating with the communities that will be impacted by the project's construction and operation, and to continue a comprehensive public outreach strategy to inform residents of the risks and impacts as a result of the proposed project.

EPA believes that comprehensive public outreach is part of any successful mitigation strategy. This should include, but is not limited to, targeted outreach campaigns to neighbors, informational literature, and updated websites. Specific resource impacts where EPA believes this would particularly beneficial, includes, but is not limited to:

construction schedule; work shifts and the resultant traffic expectations;

noise monitoring;

air quality monitoring data;

radiological data;

dewatering at the construction site and the resultant lowering ofwell levels;

refueling outages and the resultant increase in onsite personnel;

contact information for complaints and questions; and

emergency preparedness information.

Recommendations: EPA encourages the applicant to continue a comprehensive public outreach strategy to inform residents to the risks and impacts as a result ofthe proposed project. This should include, but is not limited to, targeted outreach campaigns to neighbors, informational literature, and updated websites. (**0142-21** [Mueller, Heinz])

Comment: Aesthetics
According to the DEIS, the closest residence is "0.74 mi south/i-om the site ofthe proposed Lee Nuclear Station Units I and 2, separated by woodland and the Broad River such that the proposed Lee Nuclear Station Units 1 and 2 and associated structures may be visible. In addition, the proposed units and associated structures may be visible from the Broad River and residence along McKowns Mountain Road. "

Recommendations: Local residents may experience benefits and burdens associated with this project, and should be involved in meaningful discussions with the project team throughout the decision-making process. Every effort to meaningfully involve and outreach to residents closest to the site and with increased visibility to the proposed structures and its emissions should be made. (**0142-23** [Mueller, Heinz])

Response: *These comments are directed to Duke, and the NRC does not have the authority to require such conditions and mitigation. Socioeconomic impacts such as aesthetic impacts from construction and operation of the Lee Nuclear Station are discussed in Sections 4.4 and 5.4 of the EIS. No changes were made to the EIS as a result of these comments.*

E.2.10 Comments Concerning Environmental Justice

Comment: Section 5.5.2.1, Page 5-51, Line 14: The DEIS refers to "Section 4.5.3.1.", but there is no such section. (**0134-54** [Fallon, Chris])

Response: *The EIS has been updated to reflect the correct reference to Section 2.6.3.*

Comment: Pond C's creation would displace residents of up to 86 homes and mobile homes, mostly low income folks. I visited a few of them earlier today. The average per capita income of residents who would be displaced is below $16,000. (**0012-7-5** [Hicks, Katie])

Response: *The 86 housing structures have been demolished or removed and residents were provided with relocation services. These socioeconomic impacts from building and operating the Lee Nuclear Station are discussed in Sections 4.4 and 5.4 of the EIS and environmental justice impacts are discussed in Sections 4.5 and 5.5 of the EIS. No change to the EIS was made as a result of this comment.*

Comment: Finally, the draft EIS does not adequately address the range of environmental injustices we feel that this plant could create. The assessment included in the EIS only looks at demographics in the surrounding 50-mile radius as a whole, failing to include any pockets of low income or minority residents who could be selectively and disproportionately impacted by the facility. For example, the residents I visited earlier today displaced by Pond C would be mostly low to mid income, meaning relocating could be even more difficult for them. The residents of Union, whose water supply could be threatened by withdrawals and discharges to the Broad, could also be looked at in terms of those demographics. Those are just a few examples of the many direct and indirect ways in which this plant could severely impact vulnerable communities and populations. (**0012-7-7** [Hicks, Katie])

Response: *The environmental justice analysis was conducted in accordance with NRC guidance. The methodology used in this analysis is described in Section 2.6 of the EIS. The staff uses as guidance the Revision 1 of Addressing Construction and Preconstruction Activities, Greenhouse Gas Issues, General Conformity Determinations, Environmental Justice, Need For Power, Cumulative Impact Analysis, and Cultural/Historical Resources Analysis Issues in*

Environmental Impact Statements (NRC 2011b) and the Commission's Policy Statement on the Treatment of Environmental Justice Matters in NRC Regulatory and Licensing Actions (69 FR 52040). As stated in the NRC guidance, analyses of census data is done at the census block group level and provides information for geographic areas of approximately 1000 people each, on average, and as such provides sufficient geographic detail to assess the impact of the Lee Nuclear Station on minority and low-income populations. The Make-Up Pond C site was not in a census block group that was flagged as low-income based on the methodology in Section 2.6 of the EIS. Environmental justice impacts from building and operating the proposed Lee Nuclear Station are discussed in Sections 4.5 and 5.5 of the EIS. No change to the EIS was made as a result of this comment.

Comment: Environmental Justice (EJ)

The DEIS includes demographic and impact data related to minority and low-income populations. It indicates that the nearest minority and/or low-income populations of interest are located approximately 8 miles from the project site in Gaffney, SC. In addition, small pockets of migrant workers were identified in York and Cherokee Counties.

According to Section 2.6.5, low-income and minority populations within the 50-mile radius were found within the 50-miles radius that exceeded the criteria established for the EJ analysis. Therefore, NRC assessed the potential for disproportionately high and adverse health and environmental impacts, and concluded that there are no environmental pathways by which the identified EJ populations in the 50-mile region would be likely to suffer disproportionately high and adverse environmental or health impacts as a result of the proposed construction activities. The DEIS does indicate that subsistence fishing activities in York County were noted during a community surveyor interview, but concluded that the overall impacts of construction would be small. No additional mitigation efforts beyond the strategies outlined by Duke in their Environmental Report (ER) would be warranted (page 4-88).

Recommendations: EPA appreciates your previous outreach activities and the EJ assessment data in the DEIS. EPA notes that communities with EJ concerns may experience benefits and burdens associated with this project, and should be involved in meaningful discussions with the project team throughout the decision-making process. We encourage the project team to continue coordinating with the communities that will be impacted by the project's construction and operation. A project of this magnitude and scope has the potential to impact area residents, businesses and cultural resources, and project planning should take into consideration community concerns and appropriate mitigation measures. Meaningful involvement and discussion of project issues should take place throughout project planning.

We recommend that the FEIS provide additional discussion and information regarding potential socioeconomic impacts to EJ populations regarding the following concerns:

1. Clarify the potential for jobs for low-income and minority populations related to the implementation of the project. The FEIS should indicate whether the applicant plans to engage in local job training and job fairs for area residents and businesses within the vicinity of Lee Nuclear Station.

2. Discuss impacts to residences and schools in communities with EJ concerns due to construction activities (e.g., air quality, noise). EPA notes that approximately 86 housing structures will be demolished during the inundation of Make-Up Pond C. While it appears that many of these residents have already relocated, the FEIS should indicate what proportion of these relocation impacts involved low-income and minority populations. EPA also notes that there is some discussion regarding impacts to local schools in terms of their ability to absorb an influx of residents. However, the FEIS should clarify whether any of these schools, particularly those closest and/or most affected by the project, are located in communities with EJ concerns and whether project-related impacts, such as noise, will be an issue.

3. Discuss the impacts to businesses in and serving communities with EJ concerns, during both construction and operation of the project.

4. Develop an ongoing mechanism to access facility representatives to ensure that questions, concerns or recommendations that may arise during the construction and operation of the facility can be appropriately addressed.

5. Summarize EJ-related comments from community engagement activities and provide a responsiveness summary. The FEIS should also include copies or summa (**0142-22** [Mueller, Heinz])

Response: *The workforce necessary to build and operate a nuclear plant depends on a number of factors, including job requirements and occupational skills of the local workforce. Based on past experience from large-scale construction projects, Duke estimated that at least 1350 local construction workers necessary during peak construction would reside within the region (i.e., within commuting distance to the plant). Information on the construction workforce estimates and plant employee estimates is found in Chapters 4 and 5 of the EIS. The 86 housing structures have been demolished or removed and residents were provided with compensation and relocation services. The Make-Up Pond C site was not in a census block group that was flagged as minority or low-income based on NRC methodology described in Section 2.6 of the EIS. The nearest census block group with environmental justice populations is several miles from the site. As discussed in Section 4.5.2 of the EIS, no physical impact of construction is expected to disproportionately and adversely impact environmental justice communities. All comments, including environmental justice-related comments provided to the NRC are included in Appendices D and E of the EIS. A summary of discussions with local community officials and members are available on the NRC docket (Niemeyer 2008, NRC and*

PNNL 2008). Environmental justice impacts from building and operating the proposed Lee Nuclear Station are discussed in Sections 4.5 and 5.5 of the EIS. The NRC's NEPA responsibilities end when the Commission makes its permitting decision. Therefore, an "ongoing mechanism to access facility representatives..." is beyond the authority of the NRC. No change was made to the EIS as a result of this comment.

E.2.11 Comments Concerning Historic and Cultural Resources

Comment: Our office has been in consultation with the Nuclear Regulatory Commission (NRC), the Army Corps of Engineers (COE), and Duke Energy over the past several years on this project. The licensing and operation of the Lee Nuclear Station includes the following Area of Potential Effects (APE): * Lee Nuclear Station site * Make-Up Pond C * Transmission line corridors * Railroad spur corridor.

Our office worked with Duke Energy to develop both direct and indirect APEs for these four areas of the project. Over the course of several years, Duke Energy conducted cultural resources surveys, evaluations, and viewshed assessments of the APEs for Lee Nuclear Station. The following historic properties have been identified in the APEs: * Smiths Ford Farm - eligible for the National Register of Historic Places under Criterion A; transmission line corridor * Reid-Walker Johnson Farm eligible for the National Register of Historic Places under Criterion A; transmission line * Ellen Furnace Works (38CK0068)-listed in National Register of historic places; Railroad Spur * Ninety-Nine Islands Dam-eligible for the National Register of Historic Places under Criteria A and C; Lee Nuclear Station Site (visual APE); transmission line corridor * Ninety-Nine Islands Hydroelectric Project-eligible for the National Register of Historic Places under Criterion A; Lee Nuclear Station Site (visual APE); transmission line Corridor Cemeteries/burial grounds identified during surveys: * 38CK0019 (Stroup Cemetery)-Lee Nuclear Station site * 38CK0141 (Moss Cemetery)-Lee Nuclear Station site * McKown Family Cemetery-Lee Nuclear Station site * Unnamed cemetery-Lee Nuclear Station Site * 38CK0142 (Service Family Cemetery)-Make Up Pond C * 38CKOl72 (possible NA burial site)-transmission line.

Our office believes that the proposed Lee Nuclear Station, Make-Up Pond C, railroad spur, and transmission line corridors will cause no adverse effect on the identified historic properties provided that the following conditions are met: * Public access to cemeteries upon request is not limited * Fencing around cemeteries is maintained * Cemeteries are periodically monitored for vandalism or disturbance * Service Family Cemetery is relocated in consultation with our office and interested parties * Any construction, ground disturbance, or future improvements along the railroad corridor within the boundaries of38CK0068 (Ellen Furnace Works) are limited to the existing railroad right of way or are coordinated with our office We expect that these conditions will be met by the execution of a Cultural Resource Management Plan and Agreement between our office, Duke Energy, the Corps of Engineers, and the interested Native American tribes.

Our office has met with Duke and the Corps to develop a draft of this management plan and agreement. (**0109-1** [Dobrasko, Rebekah])

Response: *The NRC appreciates the feedback provided by the South Carolina State Historic Preservation Officer (SHPO) during consultation over the past few years and this current review of the draft EIS. The EIS has been modified to reflect final SHPO concurrence with the review team's findings and the conditions that must be met to support the finding of no adverse effects to the identified historic properties and cultural resources. The final cultural resources management plan and associated Memorandum of Agreement between the SHPO, Duke Energy, the Corps of Engineers, and the interested Native American tribes have also been incorporated into the EIS. Sections 2.7.4, 4.6.1.1, 4.6.2.1, and 5.6 of the EIS were changed as a result of this comment.*

Comment: Sections 4.6.1 and 4.6.1.1, Pages 4-92 and 4-93: Duke Energy does not believe there is any basis for determining that the Service Family Cemetery is culturally important to local members of the community. Descendents of the Service and Gaffney families did not contact Brockington and Associates about the Service Family Cemetery; rather, three descendents affirmed that they would be interested in visiting the cemeteries upon being contacted by Brockington and Associates. One of these individuals never followed up on the request (Duke 2010d). Regardless, it does not appear that determinations of a Moderate impact should be made when properties in which a few individuals have expressed interest are affected. The determination of a Moderate impact does not appear to align with NUREG-1437. (**0134-46** [Fallon, Chris])

Response: *As discussed in Sections 2.7 and 4.6 of the EIS, expressions of interest in the Service Family Cemetery and historic cemeteries in general are documented from local citizens, communities in the region, and the South Carolina SHPO, providing a clear indication of cultural importance and need for mitigation of direct impacts to the Service Family Cemetery through relocation in consultation with the South Carolina SHPO. The review team's determination of MODERATE impact is consistent with the threshold of environmental effects that are sufficient to alter noticeably, but not destabilize important attributes of the identified historic properties and cultural resources established under NRC general environmental guidance (Generic Environmental Impact Statement for License Renewal of Nuclear Plants [NRC 1996] and NRC's Environmental Review Plan [NRC 2000a]). No changes were made to the EIS as a result of this comment.*

Comment: To Duke Energy's knowledge, neither SHPO nor any local historians have indicated that any of the family cemeteries or the potential burial site 38CK172 along the transmission lines, have historic value and contribute substantially to the area's sense of historic character. Therefore, the impact significance level for the Lee Nuclear Station, and alternative sites in Chapter 9 that affect cemeteries, should be Small. (**0134-47** [Fallon, Chris])

Response: *As discussed in Sections 2.7, 4.6, and 5.6 of the EIS, expressions of interest in historic cemeteries and the possible human burial site (38CK172) are documented from local citizens, communities in the region, the South Carolina SHPO, and the Eastern Band of Cherokee Indians, providing a clear indication of cultural importance. The review team's determination of MODERATE impact for the proposed Lee Nuclear Station and associated offsite developments is consistent with the threshold of environmental effects that are sufficient to alter noticeably, but not destabilize important attributes of the identified historic properties and cultural resources, under the mitigations described in Section 4.6 and 5.6. As discussed in Sections 9.3.3.7, 9.3.4.7, and 9.3.5.7 of the EIS, determinations of MODERATE impacts for preconstruction activities associated with the Perkins, Keowee, and Middleton Shoals alternative sites are not based solely on the presence of historic cemeteries or possible human burial sites. Additional National Register-eligible, potentially National-Register-eligible historic properties, and sensitive cultural resources are known to occur in direct and indirect areas of potential effect for construction and preconstruction, justifying the review team's findings of MODERATE impacts. No changes have been made to the EIS as a result of this comment.*

Comment: Section 5.6, Page 5-54, Lines 11-22: This paragraph is specific to "construction and preconstruction" activities only, not operations, and thus could be deleted from Chapter 5 addressing operations. (**0134-55** [Fallon, Chris])

Response: *This comment identifies an editorial error in Section 5.6. The words "construction and preconstruction" have been removed and replaced with "operations" in the discussion in Section 5.6. The remainder of the paragraph is retained because the important concepts regarding integration of the National Historic Preservation Act and NEPA are applicable to all aspects of the Lee Nuclear Station site environmental review, including operations.*

Comment: Section 9.3.3.7, Page 9-87, Line 6: Reference Duke 2010t should be included in the list of references.
(**0134-77** [Fallon, Chris])

Response: *This comment identifies a missing reference. It has been added to the EIS.*

Comment: Table G-11, page G-24: Site# 38CK172 is listed as not NRHP eligible but culturally important, citing reference ACC 2009. The SHPO had no specific comment on cultural importance. ACC 2009 concludes 38CK172 is not significant archeologically but is protected under federal and state burial laws. Duke Energy has discovered no other documentation justifying 38CK172 as culturally important. The DEIS provides no documentation justifying 38CK172 as culturally important. Duke Energy recommends removing the reference to 38CK172 as a culturally important resource.
(**0134-88** [Fallon, Chris])

Response: *The possible human burial site, 38CK172, located in the direct, physical area of potential effects for transmission lines is discussed in Sections 2.7.3, 4.62, and 5.6 of the EIS. As noted in these discussions and by the commenter, cultural resource investigators do conclude that the possible human burial site, 38CK172, is "not archaeologically significant" and that it is "protected under state and federal burial laws" (ACC Inc 2009:91). Investigators also recommend the possible burial as a "potentially eligible" resource (ACC Inc 2009:54) that "should not be disturbed" (ACC Inc 2009:91) and that "all impacts to the possible grave site (38CK172) should be avoided" (ACC Inc 2009:102). The Eastern Band of Cherokee Indians have also expressed specific concern about 38CK172 and highlighted the need to protect the possible human remains under State and Federal law (EBCI 2009). As a result of this feedback, 38CK172 is specifically addressed in the cultural resources management plan and Memorandum of Agreement finalized between Duke, the South Carolina SHPO, Tribal Historic Preservation Officers, and the USACE. Failure to adequately protect the human remains that may be located there could result in violations of Federal and/or State law. The review team determined that the short phrase, "culturally important," captured the essence of the information obtained and tribal concerns expressed for the protection of 38CK172 during the building and operation of offsite transmission lines for the Lee Nuclear Station Site. No changes were made to the EIS as a result of this comment.*

Comment: Historic Preservation
We appreciate the thorough discussion of cultural and historic resources in the DEIS, and your coordination with the South Carolina SHPO and THPOs. The DEIS notes that one cemetery will need to be relocated due to groundbreaking activities, and that the SHPO concurred with the finding of no historic properties affected and recommendations for relocation of the Service Family Cemetery. We also note that the South Carolina SHPO concurred that the proposed transmission lines will cause no adverse effects to two historic farmsteads and no effects on any other historic properties.

Consultation under Section 106 of the NHP A is ongoing, and will not be complete until the draft cultural resources management plan and MOA between Duke, the USACE, the South Carolina SHPO, and interested THPOs are finalized.

The DEIS states that "For the purposes of the NEPA analysis, impacts cannot be fully assessed until the draft cultural resources management plan and MOA between Duke, the USACE, the South Carolina SHPO, and interested THPOs implementing Duke Energy's corporate policy for cultural resources consideration at the Lee Nuclear Station site and associated developments in the site vicinity and offsite areas are finalized. Presently, the review team does not expect any significant impacts to historic and cultural resources during operation of proposed Lee Nuclear Station" (page 5-59).

Recommendations: The FEIS should include an update of coordination activities with the SHPO and THPOs, along with the finalized decision documents, if available.
(**0142-26** [Mueller, Heinz])

Comment: [In addition, updated information regarding:] ...historic preservation should be included in the FEIS. (**0142-32** [Mueller, Heinz])

Response: *The NRC appreciates the EPA's review of the draft EIS and per the recommendations, has incorporated the final cultural resource management plan and associated Memorandum of Agreement into the EIS.*

E.2.12 Comments Concerning Meteorology and Air Quality

Comment: Whereas, nuclear plants produce electricity at high levels of such reliability while emitting no greenhouse or acid rain gases. (**0013-1-4** [Moss, Representative Dennis])

Response: *This comment generally supports nuclear power as a clean energy alternative. It does not provide any specific information relating to the environmental effects of the proposed action, and no change was made to the EIS as a result of this comment.*

Comment: The same study did a carbon footprint comparison and it showed that nuclear had the third highest carbon footprint among the same 20 candidates, worse only than conventional coal and tar sands. I have the references here. It's true nuclear doesn't produce CO2 when the plant is working, however, if you look at all the energy that's required putting into it, building it, dismantling it, the whole ball of wax, the carbon footprint of nuclear is not good. (**0012-13-2** [Howarth, Robert F.])

Comment: There are lots of green house emissions involved in the mining & transportation of uranium, as well as the building of the plant. (**0085-2** [Allison, Patricia])

Comment: [The following problems are among those we have identified:] The false claim that nuclear power has no carbon footprint, which ignores the huge carbon footprint involved in the entire nuclear chain: mining and processing the uranium, building the nuclear facilities, transporting fuel rods to and radioactive waste from nuclear power plants, etc.
(**0119-22** [Thomas, Ruth])

Response: *The comments relate to greenhouse gas emissions released during the uranium fuel-cycle activities. The NRC staff evaluated the impacts from the life-cycle of fuel production, construction, operation, and decommissioning of the Lee Nuclear Station. The results of this analysis are presented in Chapters 4, 5, and 6 of the EIS. The generic impacts of the fuel cycle are codified in 10 CFR 51.51(b), Table S-3, Table of Uranium Fuel Cycle Environmental Data. Per the guidance in 10 CFR 51.51, the staff relied on Table S-3 as a basis for the impacts of uranium fuel-cycle impacts (including fossil emissions) to include uranium mining and milling. A* *comparison of CO_2 footprints of nuclear power and reasonable baseload energy alternatives is presented in Section 9.2.5. Appendix J of the EIS presents a detailed breakout of the CO2 footprint of a nuclear power plant. No changes were made to the EIS as a result of these comments.*

Comment: Do you also know that nuclear power increases the damaging effects of climate change?
(**0121-3** [Wallace, Kristine])

Response: *The impacts of nuclear power generation on climate change are addressed in the EIS in Chapters 4, 5, 6, and 7. No changes were made to the EIS as a result of this comment.*

Comment: The NRC incorrectly assesses greenhouse gas emissions and impacts on global warming Greenhouse gases rank among the top environmental concerns today. These emissions from many sources, in aggregate, are contributing to the destabilization of climate on planet Earth. Yet, regarding greenhouse gas emissions, the draft EIS states:

"The review team concluded that the atmospheric impacts of the emissions associated with each aspect of building, operating, and decommissioning a single plant are minimal. The review team also concluded that the impacts of the combined emissions for the full plant life cycle would be minimal."

These statements are fundamentally incorrect because the full range of alternatives was summarily dismissed. In the comparison of greenhouse gas impacts by power source, the draft EIS states:

However, because these alternatives were determined by the review team not to meet the need for baseload power generation, the review team has not evaluated the CO2 emissions quantitatively.

Phillip Smith and Willem Storm van Leeuwen report that a variety of negative factors, including the greenhouse gas emissions, make modern nuclear power plants a bad bargain:

"The exceedingly large and long-term energy debt, combined with the insecurities of the nuclear energy system will seriously delay the transition of the world energy supply to a really sustainable one. A delay we cannot afford. The nuclear option would absorb a disproportionate part of the ability to cope of the society in a ever diverging need for energy, high quality materials and human skills."

William States Lee III would not help the climate crisis, despite Duke Energy’s claims. It is important that all public investment in global warming solutions rest on scientifically solid ground. NRC's draft EIS fails to include a proper analysis of the global warming environmental impacts of construction, operation and nuclear waste management from of these reactors. (**0130-2** [Zeller, Lou])

Response: *The comment states that climate change impacts from construction, operation, and decommissioning of the proposed Lee Nuclear Station were not adequately considered in the EIS. Climate change impacts from the proposed action are discussed throughout the EIS. Section 4.7.1 discusses the preconstruction and construction impacts on greenhouse gases, Section 5.7.2 discusses the operational impacts on greenhouse gases, and Section 6.1.3 discusses the fuel-cycle impacts. Appendix J contains the details behind these discussions. The comment also questions why the EIS does not discuss the* CO_2 *emissions from all alternative energy sources. The proposed action involves baseload electrical power generation. The review team determined that certain energy alternatives do not meet the purpose and need for the action (i.e., they are not considered baseload), and therefore expanding the comparison of the* CO_2 *footprint of nuclear power and energy alternatives would not serve the purpose of NEPA. The comparison of* CO_2 *emissions from nuclear power and other alternatives capable of providing baseload electrical power is presented in Section 9.2.5. No changes were made to the EIS as a result of this comment.*

Comment: Whereas the fossil fuel inputs at every step of the process from mining fabrication, transport, and construction is high the carbon footprint of nukes negates nearly 70 percent of available energy output. (**0013-11-6** [Smith, Coleman])

Comment: A nuclear plant does create quite a lot of carbon emissions in its construction, from the mining to the transportation, etc. So it is not true to say it is carbon neutral. (**0084-2** [Lemoing, Melissa])

Comment: This project is not carbon neutral. It has a much larger cost in carbon through the building of the infrastructure, and the transportation of hazardous materials. (**0086-1** [Rylander, Kimchi])

Response: *These comments concern the greenhouse gas emissions of the entire fuel cycle and operation of the proposed Lee Nuclear Station. The discussion and impacts of greenhouse gas emissions, or the carbon footprint, from the life-cycle of fuel production, construction, operation, and decommissioning of the unit and for energy alternatives were presented in Chapters 4, 5, 6, 7, 9 and in Appendix J of the EIS. No changes were made to the EIS as a result of these comments.*

Comment: *Air Quality*
Cherokee County is designated as being in attainment or unclassified for NAAQS criteria pollutants (page 2-171). The DEIS states that development activities at the Lee Nuclear Station site would result in temporary impacts on local air quality (page 4-97). The project team

concludes that the cumulative impacts on air quality from the additional air emissions from intermittent operation of diesel generators at the Lee Nuclear Station site would be minimal, and that mitigation would not be warranted (page 7-42).

Duke plans to develop a mitigation plan to identify specific mitigation measures to control fugitive dust and other emissions (page 4-97). A mitigation plan should also include strategies to reduce $C0_2$ emissions. The DEIS concludes that the impacts from construction and preconstruction activities on air quality would not be noticeable because appropriate mitigation measures would be adopted.

Recommendations: The FEIS should include updated information regarding the status of the mitigation plan development, including the mitigation plan, if available. Plans for mitigation should be documented and committed to in the decision documents. (**0142-18** [Mueller, Heinz])

Comment: [In addition, updated information regarding:] ...air quality...should be included in the FEIS. (**0142-31** [Mueller, Heinz])

Response: *Section 4.7 of the EIS examines air-quality impacts associated with construction and preconstruction; emissions would be predominately dust from building activities and exhaust from equipment and vehicles. As noted in Sections 4.7.1 and 4.7.2 of the EIS, Duke stated in its ER that it would develop a fugitive dust control plan and traffic mitigation measures to limit emissions. Duke would develop these plans <u>to be consistent with SCDHEC regulations</u> prior to commencing building activities. Conclusions in the EIS account for some or all of these mitigation measures being implemented. There is currently no updated information regarding these mitigation measures. No change was made to the EIS as a result of these comments.*

Comment: Section 7.12, Page 7-54, Table 7-4, Air quality - greenhouse gas emissions: Add sentence in the middle column for this item. "The proposed W. S. Lee Nuclear plant would not significantly contribute to greenhouse gas emissions in the region." This would summarize the conclusions made in DEIS Sections 4.7, 5.7, 6.1.3, 6.3, 7.6.2, 7.6.3, and Table 7-3. (**0134-66** [Fallon, Chris])

Response: *Section 7.12, Table 7-4, was modified to reflect this comment.*

Comment: *<u>Greenhouse Gases (GHGs)</u>*
We appreciate your discussion of climate change and GHGs in the DEIS. The DEIS states that the majority of the potential carbon dioxide ($C0_2$) emissions of the proposed nuclear power station would be the life cycle contributions associated with the uranium fuel cycle (page 6-10).

The DEIS notes that such emissions primarily result from the operation of fossil-fueled power plants that provide the electricity needed to manufacture the nuclear fuel.

The DEIS concludes that the atmospheric impacts of the emissions associated with each aspect of building, operating, and decommissioning a single plant are minimal. In addition, the DEIS concluded that the impacts of the combined emissions for the full plant life cycle would be minimal (page 7-42).

Section 6.1, Table 6-1, Table of Uranium Fuel Cycle Environmental Data, needs clarification regarding what the center "total" column refers to, and how the references to the model plant compare to the proposed William States Lee Nuclear Station. The information should be organized in a manner that is easy to read and understand.

Section 6.1.3, Fossil Fuel Impacts, states in the 3rd paragraph "The CO_2 emissions from the fuel cycle are about 5 percent of the CO_2 emissions from an equivalent fossil fuel-fired plant." Please clarify whether this is in comparison with coal-fired power plants. Also, natural gas combined cycle turbine plants (NGCT) are also "fossil fuel-fired plants" which have less CO_2 emissions than coal plants, so the statement seems misleading. The FEIS should clarify which type of fossil fuel power plant is being referred to. While this difference appears "small", it appears that the 5% value is being compared to a conventional power plant, instead of the newer "cleaner" fossil fuel-fired power plants (such as NGCC turbine plants), which emit about 30% less CO_2 than coal plants.

Section 6.1.3, (page 6-10), also states that the NRC staff estimates that the carbon footprint for 40 years of fuel-cycle emissions would be approximately 51,000,000 metric tonnes (MT) an emissions rate of about 1,300,000 MT annually, averaged over the period of operation of CO_2. In comparison, a new natural gas combined cycle turbine plant (NG CT) of 1250 MW would have a potential to emit (PTE) of about 4.2 million short tons of CO_2e (which is about 3.8 million MT). Based on the math, the CO2 emissions are about 14% of what a new NG CT plant would be.

Recommendations: The FEIS should clarify the basis of comparison for the impacts of the proposed Lee Nuclear Station discussed in Section 6.1.3. In addition, Table 6-1 should be revised for clarity. Please refer to EPA's website (www.epa.gov/climatechange) for useful information on climate change. (**0142-19** [Mueller, Heinz])

Comment: [Also, EPA recommends that the FEIS include:] ...clarification of the GHG evaluation data... (**0142-29** [Mueller, Heinz])

Response: *The comments primarily focus on impacts to air quality from the uranium fuel cycle. Section 6.1, Table 6-1, is a reproduction of Table S–3 in 10 CFR 51.51(b). The "total" column refers to the total impact on the resource from the uranium fuel cycle during one reference reactor-year. This is described in Section 6.1 as a 1000-MW(e) LWR reactor operating at 80 percent capacity with a 12-month fuel reloading cycle and an average fuel burnup of 33,000 MWd/MTU. This is a"reference reactor-year" (Table S–3 or NUREG-1437; NRC 2013).*

To evaluate the environmental impacts of the nuclear fuel cycle for the proposed Lee Nuclear Station, the NRC staff multiplied the values in Table S-3 by a factor of 3. This scaling factor is discussed in Section 6.1 and accounts for the increased electric generation and capacity factor of the two proposed units at Lee Nuclear Station as compared to the reference reactor. Section 6.1 of the EIS has been modified for clarity in response to these comments. Section 6.1.3 discusses fossil fuel impacts of the uranium fuel cycle. The statement "The CO_2 emissions from the life cycle are about 5 percent of the CO_2 emissions from an equivalent fossil-fuel-fired plant" is referring to a coal-fired power plant. Table 6-1 compares emissions from a reference reactor to a 45 MW(e) coal-fired power plant. Accounting for differences in generating capacity, the reference reactor emits about 5 percent of that of a coal-fired power plant. Section 6.1.3 of the EIS has been modified to clarify the type of fossil-fuel-fired plant. The CO_2 emissions from a nuclear power plant are also a small percentage of those from a natural gas combined-cycle plant. Using the example in the comment which contains a specific emission rate for the natural gas combined-cycle turbine plant, the CO_2 emissions from the life cycle of a nuclear power plant are still comparatively small to those of a natural gas combined-cycle turbine plant, and the NRC staff's conclusion remains the same.

Comment: One of the things in the cumulative impacts part of the presentation was that there were moderate impacts to land use, surface water use, terrestrial and aquatic ecology, traffic, and this last one got me -- was greenhouse gas emissions, whereas, you know, the whole reason that this is being presented as a viable option is because -- to limit greenhouse gas emissions, but, yet, as far as cumulative impacts, greenhouse gas emissions are moderate. (**0013-30-1** [McWherter, Lisa])

Response: *The review team found that the cumulative impacts of greenhouse gas emissions were MODERATE. As discussed in Section 7.6.3, the review team found that the national and worldwide cumulative impacts of greenhouse gas emissions are noticeable but not destabilizing. The review team concludes that the cumulative impacts, which include impacts from other past, present, and reasonably foreseeable future actions, would be noticeable but not destabilizing, with or without the greenhouse gas emissions from the Lee Nuclear Station site.*

Evaluation of cumulative impacts of greenhouse gas emissions requires the use of a global climate model. The review team looked to the EPA finding regarding greenhouse gases. On December 15, 2009, the Administrator of the EPA issued (74 FR 66496) her determination under her authority under the Clean Air Act that: "… greenhouse gases in the atmosphere may reasonably be anticipated both to endanger public health and to endanger public welfare…." The Administrator reached her determination by considering both observed and projected effects of greenhouse gases in the atmosphere, their effect on climate, and the public health and welfare risks and impacts associated with such climate change. The review team's assessment that the cumulative impacts of greenhouse gas emissions reflect conditions within the NRC's impact category level of MODERATE for air quality related to greenhouse gases, *noticeable, but not destabilizing, is entirely consistent with the EPA Administrator's finding. No changes were made to the EIS as a result of this comment.*

Comment: [EPA recommends the FEIS include...] ...a discussion of opportunities to reduce GHG and other air emissions during construction and operation of the facility. Specifically, energy efficiency and renewable energy should be a consideration in the construction and operation of facility buildings, equipment, and vehicles. (**0142-28** [Mueller, Heinz])

Response: *Section 4.7.1 of the EIS was modified to include more detail on mitigation measures that would reduce greenhouse gas and other air emissions during building of the proposed facility. As discussed in Section 5.7.2, during operation of the proposed facility, the primary contributors to air emissions would be operation of standby generators, which are subject to an operating permit through the SCDHEC, and emissions from worker vehicles. Section 5.7.2 currently discusses the mitigation measures that the applicant would consider to reduce worker vehicle emissions.*

E.2.13 Comments Concerning Nonradiological Health

Comment: Section 9.3.5.9, Page 9-196, Lines 8-10: The DEIS states: "Impacts from building activities, including the associated transmission lines and a 2200-ac supplemental cooling-water reservoir at the Middleton Shoals site would be minimal." The Duke Energy response to RAIs 127 and 131 updated the size of the reservoir to 3700 ac. (**0134-83** [Fallon, Chris])

Response: *The size of the Middleton Shoals supplemental cooling-water reservoir was corrected in Section 9.3.5.9.*

Comment: Diesel Exhaust
In addition to the EPA's concerns regarding climate change effects and GHG emissions, the National Institute for Occupational Safety and Health (NIOSH) has determined that diesel exhaust is a potential human carcinogen, based on a combination of chemical, genotoxicity, and carcinogenicity data. In addition, acute exposures to diesel exhaust have been linked to health problems such as eye and nose irritation, headaches, nausea, and asthma.

Recommendations: Although every construction site is unique, common actions can reduce exposure to diesel exhaust. EPA recommends that the following actions be considered for construction equipment:

Retrofit engines with an EPA certified or CARB verified exhaust filtration device to capture Diesel Particulate Matter before it enters the workplace.
Position the exhaust pipe so that diesel fumes are directed away from the operator and nearby workers, thereby reducing the fume concentration to which personnel are exposed.

A catalytic converter reduces carbon monoxide, aldehydes, and hydrocarbons in diesel fumes. These devices must be used with low sulphur fuels.

Ventilate wherever diesel equipment operates indoors. Roof vents, open doors and windows, roof fans, or other mechanical systems help move fresh air through work areas. As buildings under construction are gradually enclosed, remember that fumes from diesel equipment operating indoors can build up to dangerous levels without adequate ventilation.

Attach a hose to the tailpipe of a diesel vehicle running indoors and exhaust the fumes outside, where they cannot reenter the workplace. Inspect hoses regularly for defects and damage.

Use enclosed, climate-controlled cabs pressurized and equipped with high efficiency particulate air (HEPA) filters to reduce operators' exposure to diesel fumes. Pressurization ensures that air moves from inside to outside. HEP A filters ensure that any air coming in is filtered first.

Regular maintenance of diesel engines is essential to keep exhaust emissions low. Follow the manufacturer's recommended maintenance schedule and procedures. Smoke color can signal the need for maintenance. For example, bluelblack smoke indicates that an engine requires servicing or tuning.

Work practices and training can help reduce exposure. For example, measures such as turning off engines when vehicles are stopped or inactive (not performing a necessary function) for more than a few minutes; training diesel-equipment operators to perform routine inspection and maintenance of filtration devices.

When purchasing a new vehicle, ensure that it is equipped with the most advanced emission control systems available.

With older vehicles, use electric starting aids such as block heaters to warm the engine, avoid difficulty starting, and thereby reduce diesel emissions.

Respirators are only an interim measure to control exposure to diesel emissions. In most cases an N95 respirator is adequate. Respirators are for interim use only, until primary controls such as ventilation can be implemented. Workers must be trained and fit-tested before they wear respirators. Personnel familiar with the selection, care, and use of respirators must perform the fit testing. Respirators must bear a National Institute of Occupational Safety and Health (NIOSH) approval number. Never use paper masks or surgical masks without NIOSH approval numbers. (**0142-20** [Mueller, Heinz])

Response: *The comment concerns known and potential health effects of exposure to diesel exhaust, and offers strategies to mitigate such exposures. Construction equipment exhaust is* *discussed in Sections 4.7 and 4.8 of the EIS. While the NRC determined that nonradiological health impacts would be SMALL, it agrees that the measures identified in the comment would further reduce exposure to diesel exhaust. Section 4.8.1.2, Construction Worker Health, has been updated to include EPA's suggested mitigation measures.*

E.2.14 Comments Concerning Radiological Health

Comment: One is in regard to health. Nobody's talked about low-level radiation health issues, and so I have a little study. It's called the Tooth Fairy study, and probably the NRC is familiar with the Tooth Fairy study. But for -- there's been 50 years' worth of teeth that have been collected from children. And they're looked at in terms of strontium 90 -- or SR90 -- that's in those teeth. And the reason that teeth are looked at is strontium 90 is very similar in our bodies as calcium, so our bodies think that it's calcium and stores strontium 90 in our teeth and in our bones. And so strontium 90 levels are seen in counties that are within 100 miles of nuclear reactors called nuclear counties. They're -- and it's higher than in non-nuclear counties. So when this study is done, you see that in the 3000-plus counties in the United States, women living in about 1300 of those nuclear counties are at greater risk of dying from breast cancer. And the risk is even higher for men with prostate cancer. Samples of baby teeth from during the eighties exhibit a detectable Chernobyl effect, meaning that you can see the spikes based on nuclear radiation that has gone out in these baby teeth that has been collected. And also you can increasing levels of radiation from the eighties and nineties. The study is ongoing, so you can look that up. I'll give you the place to look that up in a second. And the last thing that was collected that I wanted to share with you about that particular study is that in 1997 the federal government produced an estimate from the Nevada above ground nuclear testing site from the fifties and sixties that demonstrated that the tests caused up to 212,000 U.S. cases of thyroid cancer. In general, up to then there had been virtually no long-term health effects of low-level radiation. So that's what you can't see or what's not a big accident -- what happens just over the course of time at any nuclear power plant. And that can be found -- I don't think the guy's here anymore, but for all you that can be found on the Radiation Public Health Project's website. (**0013-29-1** [Greenburg, Lori])

Comment: I want to tell you about the Tooth Fairy Project, they have been collecting 50 years worth of data on baby teeth. The reason being, radioactive Strontium-90 (Sr-90) is one of the deadliest elements, caused by fission. "The chemical structure of Sr-90 is so similar to that of calcium that the body gets fooled and deposits Sr-90 in the bones and teeth where it remains, continually emitting cancer-causing radiation".... Strontium-90 levels are significantly higher in counties located within 100 miles of nuclear reactors (nuclear Counties) than in non-nuclear counties... of the 3,000 plus counties in the United States, women living in about 1,300 nuclear counties (located within 100 miles of a reactor) are at the greatest risk of dying of breast cancer and even higher risks for prostate cancer among men. Samples of baby teeth during from the 1980s exhibit a detectable Chernobyl effect. That strontium-90 levels in U.S. baby teeth show a temporal increase-year after year, throughout the 1980s and 1990s, reflecting the impact of low-level radiation emissions from commercial nuclear reactors. And in 1997, the federal government produced an estimate from the Nevada above-ground nuclear weapons testing site of the 1950s and early 1960s that demonstrated the tests caused up to 212,000 U.S. cases of thyroid cancer. In general there has been virtually no long-term health effects studies of low-level radiation exposure, up until this study. This info can be found on The Radiation and Public Health Project's web-site. (**0099-1** [Greenberg, Lori])

Response: *In 2000, the Radiation and Public Health Project published a report entitled, "Strontium-90 in Deciduous Teeth as a Factor in Early Childhood Cancer." The report alleges that there has been an increase in cancer incidence as a result of strontium-90 released from nuclear power facilities. The report claimed that elevated levels of strontium-90 in deciduous (baby) teeth were evidence for cause of the increase in childhood cancer. Three sources of strontium-90 exist in the environment: fallout from nuclear weapons testing, releases from the Chernobyl accident in Ukraine, and releases from nuclear power reactors. The largest source of strontium-90 is from weapons-testing fallout as a result of aboveground explosions of nuclear weapons (approximately 16.9 million curies of strontium-90) (UNSCEAR 2000). The Chernobyl accident released approximately 216,000 curies of strontium-90. The total annual release of strontium-90 into the atmosphere from all U.S. nuclear power plants is typically 1/1000th of 1 curie, which is so low that the only chance of detecting strontium-90 is sampling the nuclear power plant effluents themselves. The NRC regulatory limits from effluent releases and subsequent doses to the public are based on the radiation protection recommendations of international and national organizations such as the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP). Nuclear power facilities monitor gaseous effluent releases, and licensees report the results of their monitoring to the NRC annually. NCRP has found no statistically significant excess of biological effects from strontium-90 exposures at levels characteristic of worldwide fallout, which is the greatest source of strontium-90 in the environment. Likewise, there is no new evidence that links strontium-90 with increases in breast cancer, prostate cancer, or childhood cancer rates. The NRC staff has concluded that the claims of elevated levels of childhood cancer in the vicinity of nuclear reactors in the United States caused by the release of strontium-90 during routine operations are questionable and without scientific basis to support the claims. No causal relationship has been established between the levels of strontium-90 being reported by the Radiation and Public Health Project in deciduous teeth and childhood cancer. Furthermore, there is almost unanimous consensus among the scientific community on the adequacy of current radiation protection standards. No change was made to the EIS as a result of these comments.*

Comment: And one number was pulled out of the environmental report which kind of struck me, and that is 2,100,000 gallons, 2.1 million gallons of radioactive wastewater would be discharged annually from this plant into the Broad River. This is an average number over the lifetime of the plant, 2 million gallons per year. The rate could be as much as 50 times higher, according to the environmental report submitted by Duke Energy. That is if there is no accident and nothing bad happens. (**0012-11-1** [Zeller, Lou])

Comment: If no bad things happen, earthquakes in this region -- which it's famous for -- or some other type of internal disaster does not happen, you still have 2.1 million gallons of radioactive water being discharged, according to the company's figures provided to the NRC, 2.1 million gallons of water, if none of these events happen, every single year into the Broad River. (**0012-11-3** [Zeller, Lou])

Comment: There are numerous people, families, representatives of organizations in the Gaffney area who have not received the Environmental Impact Statement or other notices or reports, nor have they been informed that there are expected to be "acceptable" releases into the air, water or soil during the nuclear plant's normal operations. For example, Duke Energy admits that 2.1 million gallons of low-level radioactive waste-water per year can be expected to go into the Broad River, and claims that this is safe for those downstream. It's thought by both Duke and the NRC that this figure might be 50% low, which means it could be 4.2 million gallons.
(**0119-17** [Thomas, Ruth])

Response: *These comments address the amount of liquid radioactive effluents projected to be released from the combined operation of the reactors at the Lee Nuclear Station site. Section 2.11 of the EIS addresses the radiological environment around the Lee Nuclear Station site. Section 3.4.3.1 addresses the liquid radioactive waste-management systems, Section 5.9 addresses the monitoring of effluent releases during operation and the impacts from these releases, and Section 7.8 addresses the cumulative radiological impacts of operating the proposed units along with existing nuclear units within a 50-mi radius of the Lee Nuclear Station site. The mean annual flow of the Broad River for water years 2000-2010 (used in Section 5.9) was 1858 cfs. The amount of liquid radioactive effluent would be a very small fraction of this and the releases must meet the requirements of 10 CFR Part 20 Appendix B. No changes were made to the EIS as a result of these comments.*

Comment: I just want to talk a little bit more about the problems with nuclear radiation. In the industry the idea of the standard man, the standard person and what amount of ionizing radiation would be a threshold level for it, I just want to comment about that, that women are about 50 percent more vulnerable to nuclear radiation than men are, having more reproductive tissue, and children and babies, I don't think I need to tell anybody about with their rapidly growing bodies, they're much more vulnerable to it also. (**0012-15-1** [Larsen Clark, Brita])

Comment: I'm concerned about the safety and health effects of toxic nuclear waste. A recently released paper from the Nuclear Information Resource Service shows that radiation is 50 percent more harmful to women than previously recognized, and I quote: "A woman is at significantly greater risk of suffering and dying from radiation-induced cancer than a man who gets the same dose of ionizing radiation." This is news because data in the report on the biological effects of ionizing radiation published in 2006 by the National Academy of Science has been under reported. It's more often acknowledged that children are at higher risk of disease and death from radiation, but it is rarely pointed out that the regulation of radiation and nuclear activity worldwide ignores the disproportionately greater harm to both women and children. I again quote: "The current limits for most industrial radiation in the United States allows failed cancer members of the general public at a rate that is between 300 to 3,000 times higher than the legal rate of harm from most other industrial hazards." And that's the legal rates, and this is a very disturbing fact. (**0012-19-1** [Howarth, Irma])

Comment: I have a farm NW of Asheville, NC. and along with my family would be subjected to any risk of radiation exposure from such a facility. (**0025-2** [Dixon, Mary])

Comment: The dangers to human life that come from exposure to these plants and to nuclear energy is well-known and well-documented. (**0031-1** [Glaser, Christine])

Comment: How can safety risks resulting from more nuclear reactors be justified, when there are increasing reports published of increased incidences of leukemias and cancers among people, especially children, associated with their proximity to nuclear power plants in the US and elsewhere? (**0058-4** [Patrie, MD, MPH, Lewis E.])

Comment: A recently released paper from the Nuclear Information Resource Service shows that radiation is 50% more harmful to women than previously recognized. I quote: "A women is at significantly greater risk of suffering & dying from radiation-induced cancer than a man who gets the same dose of ionizing radiation. This is news because data in the report on the biological effect of ionizing radiation published in 2006 by the National Academy of Sciences (NAS) has been under reported. It is more often acknowledged that children are at higher risk of disease & death from radiation, but it is rarely pointed out that the regulation of radiation & nuclear activity (worldwide) ignores the disproportionately greater harm to both women & children." I again quote "The current limits for most industrial radiation in the U.S. allow fatal cancer members of the general public at a rate that is between 300 to 3000 times higher than the legal rate of harm from most other industrial hazards." This is very disturbing!! (**0092-2** [Howarth, Irma])

Comment: Other Nuclear Factors of Concern [include:] Health effects and cost - - may be unknown initially, but show up as poor citizen health & soon impact health insurance rates. (**0093-2** [Howarth, Robert F.])

Comment: ...radiation kills and also remains in our environment for millenia. (**0111-3** [Knudten, Cori])

Comment: [Building the W.S. Lee Nuclear Plant will:] Create strong health risks for human populations of Asheville NC, Greenville/Spartanburg SC, Charlotte NC. (**0112-6** [Andrews, Josephine] [Anonymous] [Beattie, Kathryn E.] [Boever, Virginia] [Boyle, Ella] [Brogan Prindle, Cathleen] [Davis, John] [Flores, S.] [Hamahan, Clare] [Keil, A. Eugene] [Leverette, Will] [Peterson, Harry] [Peterson, Martha J.] [Rittenberg, David] [Rustin, K.])

Comment: [If Lee Nuclear Station is built:] Populations of GAFFNEY, Charlotte & nearby Asheville, NC would be endangered. (**0114-7** [Lovinsohn, Ruth])

Comment: The problem that those most vulnerable to radioactive releases from nuclear plants are children, women, and the elderly. Radiation exposure causes cancer years down the road, but it also more immediately causes miscarriages and birth defects.
(**0119-23** [Thomas, Ruth])

Comment: The BEIR VII Committee published morbidity and mortality data in 2006 which show that children have a significantly higher risk of developing cancer from radiation than adults do and women have a higher risk of radiation-induced cancer than men do. BEIR VII found that a lifetime dose of one million person-rem results in a cancer incidence rate of 900 for men and 1370 for women; mortality rates for the same dose are 480 and 660 for men and women, respectively.
(**0130-8** [Zeller, Lou])

Response: *The NRC takes seriously its responsibility under the Atomic Energy Act to protect the health and safety of the public and the environment in regulating the U.S. nuclear power industry. The NRC's mission is to protect the public health and safety and the environment from the effects of radiation from nuclear reactors, materials, and waste facilities. The NRC's regulatory limits for radiological protection are set to protect workers and the public from the harmful health effects (i.e., cancer and other biological impacts) of radiation on humans. The limits are based on the recommendations of standards-setting organizations. Radiation standards reflect extensive scientific study by national and international organizations. The NRC actively participates and monitors the work of these organizations to keep current on the latest trends in radiation protection. The NRC has based its dose limits and dose calculations on a descriptive model of the human body referred to as "standard man." However, the NRC has always recognized that dose limits and calculations based on "standard man" must be informed and adjusted in some cases for factors such as age. For example, the NRC has different occupational dose limits for declared pregnant women because the rapidly developing human fetus is more radiosensitive than an adult woman. The NRC dose limits are also much lower for members of the public, including children and elderly people, than for adults who receive radiation exposure as part of their occupation. Finally, the NRC dose calculation methods have always included age-specific dose factors for each radionuclide because they may be used differently by infant, child, and teen bodies, which are also generally smaller than adult bodies. Additionally, the calculation methods have always recognized that the diets* *(amounts of different kinds of food) of infants, children, and teens are different from adults. (See Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, issued October 1977; NRC 1977a). No change was made to the EIS as a result of these comments.*

Comment: We now -- we also know that radioactive tritium has already leaked from 48 of 65 U.S. nuclear power facilities, often in the groundwater. (**0013-16-3** [Zdenek, Dr. Joe])

Response: *The NRC has identified several instances of unintended tritium releases, and all available information shows no threat to the public. Nonetheless, the NRC is inspecting each of these events to identify the cause, verify the impact on public health and safety, and review licensee plans to remediate the event. The NRC also established a "lessons learned" task force to address inadvertent, unmonitored liquid radioactive releases from U.S. commercial nuclear power plants. This task force reviewed previous incidents to identify lessons learned from these events and determine what, if any, changes are needed to the regulatory program. Detailed information and updates on these liquid releases can be found on the NRC public website at http://www.nrc.gov/reactors/operating/ops-experience/grndwtr-contam-tritium.html. No changes to the EIS were made as a result of this comment.*

Comment: I thought it was interesting when I came in here this morning -- or this evening that somebody was passing out these radiation signs. So I grabbed one because I'm radioactive, and so are you and you and you and everyone in this room is radioactive. In fact, we're so radioactive that if you sleep with a partner you will receive more radiation exposure from that partner than you would by living next door to the Lee nuclear power plant. There's been a lot of discussion here about radiation without the qualification of the dose rate and what that dose rate means. The poison is in the concentration and the concentration of radiation from nuclear power plants is very, very low. (**0013-18-1** [Bromm, Bob])

Response: *These comments are generally related to the radiation dose a member of the public would receive daily from all sources. They do not provide specific information related to the environmental impacts of the proposed Lee Nuclear Station and therefore no changes were made to the EIS as a result of this comment.*

Comment: There's just -- toxins are cumulative. It's bad enough we have mercury and so on from coal power. We can't afford to add one bit of radiation to the toxic mix that is killing us. Now, I'm going to live to 100 or die hiking unless pollution gets me first. (**0013-31-1** [Bisesi, Philip])

Response: *This comment relates to the possible synergistic effect of chemicals and radiation and the cumulative impacts of the proposed Lee Nuclear Station reactors. The NRC staff evaluated cumulative impacts from the operation of the proposed reactors in Chapter 7 of the EIS. No change was made to the EIS as a result of this comment.*

Comment: Also, what about the normal radioactive releases that occur regularly at a nuclear facility? This pamphlet, which is available outside, from the Nuclear Information and Resource Service lists all of the many daily and annual emissions of radioactive material that occurs. And I encourage you to take this pamphlet and to research it to really question whether this is true or not. But not only do they say that there are all of these different kinds of releases -- just routine releases often -- but they also say that they are often not fully detected or reported. So in the Environmental Impact Statement are you including in that impact any of the radioactive planned releases? Finally, I want to just read this statement -- and this has been stated eloquently by others. But to emphasize again that any radioactive exposure can be cumulative and can affect people not a year from now, not ten years from now, but 15 or 20 years from now. And we know that we have a tremendous increase in all kinds of cancers and other diseases. So let me just read this in closure. It is scientifically established that every exposure to radiation increases the risk of damage to tissues, cells, DNA, and other vital molecules. Each exposure potentially can cause programmed cell death, genetic mutations, cancers, leukemia, birth defects, and reproductive, immune, and endocrine system disorders. (**0013-33-2** [Broadhead, Susan])

Comment: There are doubtless many other names that the public will never know about where releases of radioactive material have occurred on a much less dramatic scale but that nevertheless add to the increase of exposure and the subsequent increased cancer rates. I refer you to the recent studies done by the German and French governments that show increased cancer rates in the population living close to nuclear power plants. (**0060-1** [Craig, Tom])

Comment: All nuclear power plants leak dangerous substances, radioactivity and heat. (**0107-2** [Acs, Deborah])

Response: *These comments relate to the airborne and liquid radioactive effluents from the proposed Lee Nuclear Station. Chapter 2 of the EIS addresses the radiological environment around the Lee Nuclear Station site, Chapter 3 addresses the gaseous and liquid radioactive waste-management systems, and Chapter 5 addresses the monitoring of effluent releases during operation and the impacts from these releases. The EIS also assesses the environmental impacts of the uranium fuel cycle, including the impacts of solid radioactive waste management in Chapter 6 of the EIS. The NRC's mission is to protect the public health and safety and the environment from the effects of radiation from nuclear reactors, materials, and waste facilities. The NRC's regulatory limits for radiological protection are set to protect workers and the public from the harmful health effects (i.e., cancer and other biological impacts) of radiation on humans. The limits are based on the recommendations of standards-setting organizations. Radiation standards reflect extensive scientific studies by national and international organizations. The NRC actively participates and monitors the work of these organizations to keep current on the latest trends in radiation protection. If the NRC determines that there is a need to revise its radiation protection regulations, it will initiate a rulemaking. The models recognized by the NRC for use by nuclear power reactors to calculate dose incorporate* *conservative assumptions and account for differences in gender and age to ensure that workers and members of the public are adequately protected from radiation. On April 7, 2010, the NRC announced that it asked the National Academy of Sciences (NAS 1980) to perform a state-of-the-art study on cancer risk for populations surrounding nuclear power facilities (ADAMS Accession No. ML100970142). The NAS has a broad range of medical and scientific experts who can provide the best available analysis of the complex issues involved in discussing cancer risk and commercial nuclear power plants. More information on its methods for performing studies is available at http://www.nationalacademies.org/studycommitteprocess.pdf. The NAS study will update the 1990 U.S. National Institutes of Health National Cancer Institute (NCI) report, "Cancer in Populations Living Near Nuclear Facilities" (Jablon et al. 1990). The study's objectives are to: 1) evaluate whether cancer risk is different for populations living near nuclear power facilities; 2) include a listing of cancer occurrence; 3) develop an approach to assess cancer risk in geographic areas that are smaller than the county level; and 4) evaluate the study results in the context of offsite doses from normal reactor operations. Phase I of the NAS study report was published on March 29, 2012 and is available on the NAS website (http://www.nap.edu). No changes have been made to the EIS in response to these comments.*

Comment: Everybody in this room has got some nuclear particles in his or her body -- everybody. The question is what's the safe number of bullets to shoot at somebody at close range, which is what the nuclear power industry is doing. They're shooting bullets at people at close range. The answer is zero. (**0013-14-2** [Richardson, Don])

Comment: Nuclear Power Is Dangerous. Radiation exposure damages, reproductive cells, imune system - causes genetic mutations and cancer, spontaneous abortion, mental retardation, spina bifida, heart disease, leukemia and more. (National Academy of Sciences, BEIR V & V!!; World Health Organization). The truth is... we all are at risk... depends on where the water flows and the wind blows. According to the National Academy of Science, there is no safe level of radiation. You cannot taste it, smell it or see it. Health effects can show up 10-30 years later. (**0017-1** [Morgan, Tom and Barbara])

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Comment: According to the National Academy of Science, there is no safe level of radiation. You cannot taste it, smell it or see it. Health effects can show up 10-30 years later. I do not want anyone to suffer from this avoidable health risk. (**0041-2** [McMahon, John])

Comment: According to the National Academy of Science, there is no safe level of radiation. Radiation exposure damages reproductive cells, immune system?causes genetic mutations and cancer, spontaneous abortion, mental retardation, spina bifida, heart disease, leukemia and more. (National Academy of Sciences; World Health Organization). Health effects can show up 10-30 years later. (**0048-1** [Skeele, Michele and Skip])

Comment: No level of radiation is safe for the human body. (**0061-3** [Holt, Cathy])

Comment: Nuclear power is inherently dangerous. Radiation exposure damages reproductive cells and the immune system. There is no safe level of radiation. (**0082-1** [Karpen, Leah R.])

Comment: It is my opinion that building the plant poses far too great a risk to the health of citizens of our region. Radiation exposure damages reproductive cells and the immune system; it also causes genetic mutations, cancer, spontaneous abortion, mental retardation, spina bifida, heart disease, leukemia and more. (National Academy of Sciences, BEIR V & VII, World Health Organization). (**0083-2** [Broadhead, Susan])

Comment: It is my opinion that building the plant poses far too great a risk to the health of citizens of our region. According to the National Academy of Sciences and the World Health Organization, radiation exposure damages reproductive cells and the immune system; it also causes genetic mutations, cancer, spontaneous abortion, mental retardation, spina bifida, heart disease, leukemia and more. (**0098-2** [Broadhead, Susan])

Comment: Nukes have already contaminated Earth forever, and everyone in this room is carrying some radioactive particles in his or her body which is a threat to the health not only of yourself but to your progeny, even those not yet born. (**0100-1** [Richardson, Don])

Response: *The BEIR VII Summary report (National Research Council 2006) does not say that there is no safe level of exposure to radiation. The conclusions of the report are specific to estimating cancer risk and do not address "safe or not safe." The BEIR VII Summary report states: "In general the magnitude of estimated risks for total cancer mortality of leukemia has not changed greatly from estimates provided in past reports such as BEIR V and recent UNSCEAR and ICRP reports." The National Academies' "Report in Brief," June 2005, states, "In general, BEIR VII supports previously reported risk estimates for cancer and leukemia, the availability of new and more extensive data have strengthened confidence in these estimates." There is no statement about "no safe level or threshold" rather the "BEIR VII Committee said that the higher the dose, the greater the risk; the lower the dose, the lower the likelihood of harm to human health." Regarding non-cancer health effects, the BEIR VII Summary report further elaborates: "The Committee maintains that other health effects, such as heart disease and stroke, occur at high radiation doses but that additional data must be gathered before an assessment of any possible dose response can be made of connections between low doses of radiation and non-cancer health effects."*

No changes were made to the EIS in response to these comments.

Comment: The so called 10 mile and 50 mile risk area around nuclear plants doesn't hold true to the people and children of Belarus, victims of 1986 Chernobyl fallout who are still suffering debilitating diseases as a result of contamination from 124 miles away. In Japan, Fukushima has sent fallout to Tokyo and Asheville/Hendersonville (where I live) is 3 times closer to Gaffney's proposed nuclear site. The NRC quotes the research done from the Chernobyl accident where thyroid cancer in children who ate radioactive food supplies OUTSIDE the safety zones was reported. There is also Chernobyl Heart, a genetic disorder in which children in Ukraine are born with holes in their hearts. (**0017-2** [Morgan, Tom and Barbara])

Comment: The so called 10 mile and 50 mile risk area around nuclear plants doesn't hold true to the people and children of Belarus, victims of 1986 Chernobyl fallout who are still suffering debilitating diseases as a result of contamination from124 miles away. In Japan, Fukushima has sent fallout to Tokyo and Asheville is 3times closer to Gaffney's proposed nuclear site. The NRC quotes the research done from the Chernobyl accident where thyroid cancer in children who ate radioactive food supplies OUTSIDE the safety zones was reported. There is also Chernobyl Heart, a genetic disorder in which children in Ukraine are born with holes in their hearts. (**0018-4** [Vestal, Majorie] [Vestal, Majorie])

Comment: The so called 10 mile and 50 mile risk area around nuclear plants doesn't hold true for the people and children of Belarus, victims of 1986 Chernobyl fallout who are still suffering debilitating diseases as a result of contamination from 124 miles away. In Japan, Fukushima has sent fallout to Tokyo and Asheville is 3 times closer to Gaffney's proposed nuclear site. (**0048-2** [Skeele, Michele and Skip])

Comment: The so-called 10 mile and 50 mile risk area around nuclear plants did not hold true for the people of Belarus, victims of 1986 Chernobyl fallout who are still suffering debilitating diseases as a result of contamination from 124 miles away. Gaffney is closer than that to many large population centers (as well as all the rural areas), including Charlotte and Asheville. (**0083-3** [Broadhead, Susan])

Comment: I would like to draw your attention to the most recent data from Chernobyl Russia. The so called 10 mile and 50 mile risk area around nuclear power plants does not hold time to the people and children of Belarus, victims of the 1986 Chernobyl fallout who are still suffering debilitating diseases as a result of the contamination from 124 miles away. (**0087-1** [Drouin, Michaeljon])

Comment: The so-called 10 mile and 50 mile risk area around nuclear plants did not hold true for the people of Belarus, victims of 1986 Chernobyl fallout who are still suffering debilitating diseases as a result of contamination from 124 miles away. Gaffney is closer than that to many large population centers, including Charlotte and Asheville, and of course to large rural areas. (**0098-3** [Broadhead, Susan])

Comment: After the Fukushima disaster, we learned just how devastating nuclear radiation is to the land, water, people and animals. We still don't know the long term affects of Fukushima's nuclear meltdown. After the Chernobyl fallout, victims are still suffering from debilitating diseases 124 miles from the Chernobyl nuclear plant. (**0112-2** [Andrews, Josephine] [Anonymous] [Beattie, Kathryn E.] [Boever, Virginia] [Boyle, Ella] [Brogan Prindle, Cathleen] [Davis, John] [Flores, S.] [Hamahan, Clare] [Keil, A. Eugene] [Leverette, Will] [Peterson, Harry] [Peterson, Martha J.] [Rittenberg, David] [Rustin, K.])

Response: *These comments relate to the adequacy of emergency plans, which is an issue that is outside the scope of the NRC staff's environmental review. As part of its safety review for the proposed Lee Nuclear Station, the NRC staff will determine, after consultation with the U.S. Department of Homeland Security and the Federal Emergency Management Agency, whether the emergency plans submitted by Duke are acceptable will be evaluated in the Lee Nuclear Station FSER. As stated in 10 CFR 50.54, Conditions of Licenses, paragraph (q), the emergency planning zone (EPZ) consists of an area about 10 mi (16 km) in radius. The exact and configuration of the EPZ for a particular nuclear power reactor is determined in relation to local emergency response needs and capabilities as they are affected by such conditions as demography, topography, land characteristics, access routes, and jurisdictional boundaries. EPZs for power reactors are also discussed in NUREG–0396; EPA 520/1-78-016, "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants" (NRC 1978). No changes were made to the EIS in response to these comments.*

Comment: Out of 104 US reactor sites, 100 have contaminated soil leading to contaminated ground water. Why will Lee be different? (**0041-4** [McMahon, John])

Comment: Contaminated (SOIL) out of 104 US Reactor sites: at least 100 have already poisoned the Soil which in turn is poisoning our water. (**0114-10** [Lovinsohn, Ruth])

Comment: Out of 104 US reactor site now, 100 have contaminated soil leading to contaminated ground water. How could Lee be an exception? (**0133-8** [Christopher, Lucy D.])

Response: *Although NRC regulations require licensees to make surveys, as necessary, to evaluate the potential hazard of radioactive material released in order to assess doses to members of the public and workers, recent discoveries of releases at other plants indicate that undetected leakage to groundwater from facility structures, systems, or components can occur resulting in unmonitored and unassessed exposure pathways to members of the public. The NRC has identified several instances of unintended tritium releases, and all available* *information shows no threat to the public. Nonetheless, the NRC is inspecting each of these events to identify the cause, verify the impact on public health and safety, and review licensee plans to remediate the event. The NRC also established a "lessons learned" task force to address inadvertent, unmonitored liquid radioactive releases from U.S. commercial nuclear power plants. This task force reviewed previous incidents to identify lessons learned from these events and determine what, if any, changes are needed to the regulatory program. Detailed information and updates on these liquid releases can be found on the NRC public website at http://www.nrc.gov/reactors/operating/ops-experience/grndwtr-contam-tritium.html. No changes to the EIS were made as a result of these comments.*

Comment: [Building the W.S. Lee Nuclear Plant will:] Create strong health risks for human populations of Asheville NC, Greenville/Spartanburg SC, Charlotte NC. (**0004-5** [Cunningham, Kristine])

Comment: NRC regulations will not prevent elevated levels of exposure. The limits for radiation dose to individual members of the public is 100 millirem, a dose which equates to an annual risk of 5 in 100,000 (5.0xE-05) and a lifetime risk of 3.5 in 1,000 (3.5-E03). This means that 5 persons could die for every 100,000 members of the public exposed the plant's ionizing radiation for a year; 3 to 4 persons per 1,000 could die if exposed over a lifetime. (**0130-10** [Zeller, Lou])

Comment: We [residents in the immediate vicinity of the plant] are the ones who will be subject to cancers from air and water pollution, etc. (**0144-2** [Brockington, Mary Sue and William B.])

Response: *The NRC takes seriously its responsibility under the Atomic Energy Act to protect the health and safety of the public and the environment in regulating the U.S. nuclear power industry. The NRC's mission is to protect the public health and safety and the environment from the effects of radiation from nuclear reactors, materials, and waste facilities. The NRC's regulatory limits for radiological protection are set to protect workers and the public from the harmful health effects (i.e., cancer and other biological impacts) of radiation on humans. The limits are based on the recommendations of standards-setting organizations. Radiation standards reflect extensive scientific study by national and international organizations. The NRC actively participates and monitors the work of other organizations to keep current on the latest trends in radiation protection. If the NRC determines that there is a need to revise its radiation protection regulations, it will initiate a rulemaking. The public has been given the opportunity to participate in the rulemaking process that established the regulations that govern its review process. More information on NRC's roles and responsibilities is available on the NRC's Internet website at http://www.nrc.gov/what-we-do.html. No change was made to the EIS as a result of these comments.*

Comment: Section 7.8, Page 7-47, Lines 1-5: Change "The REMP would measure radiation and radioactive materials from all sources, including Lee Nuclear Station, area hospitals, and industrial facilities" to state "The REMP would measure radiation and radioactive materials based on guidance provided in NEI 07-09A." Measuring radioactive materials and radiation from area hospitals and industrial facilities is not part of the REMP. The REMP will implement the guidance provided in NEI 07-09A as described in DEIS Section 5.9.6. (**0134-65** [Fallon, Chris])

Response: *The intent of the paragraph in Section 7.8, that "The REMP would measure radiation and radioactive materials from all sources, including Lee Nuclear Station, area hospitals, and industrial facilities," is that the monitoring program will detect radiation and radioactive materials in the environment, regardless of whether from the Lee Nuclear Station site or not. The monitoring program, by itself, will not discriminate by the source of the radiation. The focus of the REMP will be impacts from the Lee Nuclear Station Units 1 and 2; the preoperational survey will give a general idea of releases from nearby non-reactor sources, although these may also change from year to year. No change was made to the EIS in response to this comment.*

Comment: Section 5.9.6 discusses Radiological Monitoring. Duke should add information to this section that clarifies when increased monitoring and notifications to the state of South Carolina and NRC will be needed if radionuclides resulting from plant operations are detected on plant property. (For example, if tritium levels in groundwater over a 3-year period trend from 10% of the 20,000 pCi/l standard to 40% of standard, the appropriate regulatory organizations will be notified. In addition, sampling frequency will be increased and an evaluation will be made to determine if additional monitoring wells are needed.) (**0142-6** [Mueller, Heinz])

Comment: *Tritium*

EPA is concerned about potential tritium leakage. The NRC staff expects that the impacts from such potential leakage for proposed Lee Nuclear Station Units 1 and 2 would be minimal (page 5-71). Further information regarding the operational surface water and groundwater monitoring program should be included in the FEIS.

Recommendations: The FEIS should include a map of the groundwater monitoring wells. While we expect tritium levels in surface water discharge areas to be significantly diluted, we would also appreciate a map of surface water monitoring points. (**0142-8** [Mueller, Heinz])

Response: *Section 5.9.6 of the EIS states "Duke ... has endorsed the [Nuclear Energy Institute (NEI)] Groundwater Protection Initiative... The goals for the Groundwater Protection Initiative will be to provide a hydrologic characterization of the constructed plant and a monitoring well network capable of providing early detection of releases through the use of near-field wells and verification of no offsite migration through the use of far-field wells. Well locations will be selected based on proximity to plant systems that may be a source of radiological releases and/or in nearby projected down-gradient groundwater flow direction from such sources. Where shallow groundwater is expected to be present, shallow wells will be used* *as first detection monitoring locations. Deeper wells will be used where plant systems are deep. Wells will be installed such that the well screen is located near the potential release location. Deep wells may be located on top of rock or into rock as appropriate. Wells may be paired, either in shallow or deep locations, to evaluate the vertical component of groundwater flow."*

Pursuant to the CWA, on July 17, 2013, the SCDHEC issued NPDES Permit No. SC0049140 to Duke for discharge to surface waters for the Lee Nuclear Station (SCDHEC 2013). In Section 5.2.4, the EIS states that Duke has committed to perform operational monitoring for groundwater and surface water that would satisfy the applicable requirements of State and Federal agencies.

The NRC concludes that it is not necessary to discuss the specific details of the effluent and environmental monitoring methods in the EIS to estimate the environmental impact of radiological effluent releases. Because the requested information has not yet been developed and is not required at this time, no change was made to the EIS in response to these comments.

E.2.15 Comments Concerning Nonradioactive Waste

Comment: Sustainable Infrastructure
EPA would appreciate more information in the FEIS regarding the planned sources of the construction materials. Please outline whether this material may be made of second-sourced material, for example, reclaimed aggregate. Please see our website regarding environmentally preferable purchasing: www.epa.gov/epp.

We encourage the applicant to consider construction of buildings in accordance with Leadership in Energy and Environmental Design (LEED) standards. If LEED standards are pursued, this information should be included in the FEIS. Also, potential use of Energy Star appliances, EPA's Water Sense program, EPA's GreenScapes program or other similar programs should be identified in the FEIS. These are important elements of reducing the overall environmental impact of the proposed project.

Recommendations: EPA recommends that elements of sustainable or "green" infrastructure be incorporated into all facets of the design and site layout, in areas where safety and site security permit. This should include consideration of, but is not limited to, using permeable pavement and re-planting construction lay-down areas with native vegetation. We recommend that all beneficial mitigation measures are outlined in the FEIS. EPA encourages the applicant to consider environmentally-friendly purchasing and sourcing, and sustainable development of the facility. Any plans currently proposed by the applicant to pursue programs or initiatives listed above should be disclosed in the FEIS.

We recommend that any auxiliary buildings, new roads, and other non-safety related structures be constructed with materials that are recycled, where feasible and where safety requirements are met. (**0142-27** [Mueller, Heinz])

Response: *Section 4.10, Nonradiological Waste, was edited to incorporate the commenter's suggestions to Duke regarding the incorporation of sustainable building practices into the development of the proposed Lee Nuclear Station. It should be noted that the NRC regulates the construction of safety-related structures, systems, and components, and performs construction oversight to ensure that proper materials are used during construction that has a nexus to radiological safety. The NRC does not have the authority to specify that the applicant procure "environmentally friendly" building materials.*

E.2.16 Comments Concerning Severe Accidents

Comment: One of them is, since there cannot be a guarantee that there will not be an accident that's just -- you cannot guarantee that no matter how many safeguards you put into place. Why doesn't an accident have to be put into the Environmental Impact Statement? Why isn't the impact of that accident part of the Environmental Impact Statement as a potential impact? (**0013-33-1** [Broadhead, Susan])

Comment: I live in Mill Spring, North Carolina, about 35 miles from the proposed project, so we would be directly affected in the event of any accidental release of radioactivity into the atmosphere. (**0079-4** [Schmitt, Brynn])

Response: *These comments concern postulated reactor accidents. The environmental impacts of postulated accidents are addressed in Sections 5.11 and 7.10 of the EIS. Tables 5-14, 5-15, and 5-16 of the EIS present estimates of the risk associated with severe accidents. As discussed in Section 5.11 of the EIS, the risks from a severe accident at the proposed reactors are lower than the risk levels for the nuclear reactors currently in operation and lower than the probability-weighted consequence levels set forth in the Commission's Safety Goals Policy statement (51 FR 30028). No changes were made to the EIS as a result of these comments.*

Comment: There's two cases: environmental impact, business as usual, and Fukushima. They are two separate cases. I hear all kinds of analysis about business as usual, job well done, great, traffic pattern analysis, that's great. How much use was that in Fukushima? It was not. (**0012-8-2** [Crissey, Brian])

Comment: In citing the radiation elevations in the U.S. the EPA stated, Elevated levels of radiation material in rainwater has been expected as a result of the nuclear incident in Japan, because they know that radiation is known to travel in the atmosphere. Two major nuclear accidents have occurred. People lost their lives, their homes, their livelihood, and families.

Today many people suffer cancer and birth defects from Chernobyl which are accurately documented. You can find that. The devastation to the land inhabited is not repairable for generations to come. These people don't go home. It's irresponsible for the NRC to approve any new nuclear plants based on all the data available, which proves accidents do happen, will happen. It's just a matter of where and when. In a letter to Senator Boxer, who's the Committee on Environment and Public works, the NRC chief Jaczko stated, Scientific studies of the Chernobyl accident have shown the ingestion was the predominant exposure pathway to populations living at distances beyond the evacuation area. This ingestion, like the drinking of contaminated milk, resulted in elevated thyroid doses and the later development in children of thyroid cancer. (**0013-7-2** [Sorensen, Laura])

Comment: Then why assume it is okay to build a nuclear power plant in a densely populated area, when we have repeatedly seen these plants malfunction with disastrous consequences? The people of Japan will be developing cancers of many sorts for many years to come as a result of the recent nuclear accident there. (**0079-3** [Schmitt, Brynn])

Comment: This probability of an accident has been show to cover much more ground than industry claims. (**0108-2** [Fisk, Bill])

Comment: "Accidents" happen, we can not prevent them, and the consequences in the case of nuclear plants are horrendous. (**0113-7** [Rose, Katherine])

Comment: The very real threat of catastrophic failure, attack or accident which could have an "environmental impact" of thousands of square miles and fallout in multiple countries, as has been the case with Chernobyl and Fukushima. (**0116-4** [Schmitt, Daniel])

Response: *The environmental impacts of postulated accidents are addressed in Sections 5.11 and 7.10 of the EIS. Protection against severe accidents is provided by regulatory requirements in two basic ways: 1) prevention of core damage events such that the likelihood of events that lead to core damage is very low; and 2) mitigation of consequences in the event of a severe accident. The NRC has determined that the combination of these two aspects does result in an acceptably low risk. However, as with almost every human endeavor, there are risks associated with the action. The NRC does not expect that the cited accidents will occur again, but the possibility cannot be entirely eliminated. No death or fatality attributable to nuclear power operation will ever be acceptable in the sense that the Commission would regard it as a routine or permissible event.*

NRC Fact Sheets that summarize the major accidents cited by the commenters can be found at:

- *http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/chernobyl-bg.html*
- *http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-japan-events.html and*
- *http://www.nrc.gov/japan/japan-info.html*

In particular regards to Fukushima Dai-ichi, since the nuclear accident at Fukushima first began to unfold, the NRC has been working to understand the events in Japan and relay important information to U.S. nuclear power plant licensees and applicants. In a significant difference from the Chernobyl accident, Japanese authorities enacted prompt countermeasures based on international guidance to minimize the radiological health impacts from the release of radioactive material from the Fukushima Dai-ichi site. This included sheltering-in-place, evacuation, radiation monitoring and surveys, and interdiction of contaminated food-stuff and drinking water. Not long after the emergency began, the NRC established a task force of senior NRC experts to determine lessons learned from the accident and to initiate a review of NRC regulations to determine if additional measures should be taken immediately to ensure the safety of U.S. nuclear power plants. The task force reported the results of its review (NRC 2011c) and presented its recommendations to the Commission on July 12 and July 19, 2011, respectively. The task force concluded that continued U.S. nuclear plant operation and NRC licensing activities presented no imminent risk. The task force also concluded that enhancements to safety and emergency preparedness are warranted and made several general recommendations for Commission consideration. On March 12, 2012, the NRC issued three orders and a request for information (RFI) to holders of U.S. commercial nuclear reactor licenses and construction permits to enhance safety at U.S. reactors based on specific lessons learned from the event at Japan's Fukushima Dai-ichi nuclear power plant as given in the task force report. The NRC staff issued companion requests for additional information to Duke requesting information to address the applicable requirements of the orders and request for information.

Section 5.11 has been revised to discuss the task force recommendations and staff requests for additional information made to the applicant related to the lessons learned from the accident at Japan's Fukushima Dai-ichi nuclear power plant. No other changes were made to the EIS as a result of these comments.

E.2.17 Comments Concerning the Uranium Fuel Cycle

Comment: [Building the W.S. Lee Nuclear Plant will:] Create radioactive nuclear waste that has to be stored locally because there is no long term storage solution. Currently there are 145 million tons of waste stored at 77 sites. Out of 104 nuclear plant storage sites, 100 have contaminated soil leading to contaminated ground water. We are leaving the problem of radioactive waste for generations to come. (**0004-4** [Cunningham, Kristine])

Comment: Ubiquitous Nuclear Waste: Storing radioactive waste on-site has contaminated ground water at many reactor sites. After more than 40 years of commercial radioactive waste generation, there is no long term location to keep it safe and contrary to many claims, no way to "recycle" it. Out of 104 US reactor sites, 100 have contaminated soil leading to contaminated ground water. Why will Lee be different? Nuclear waste remains radioactive for millions of years. This is critical to safety planning. There is currently 145 million Tons of waste at 77 US sites. (**0017-9** [Morgan, Tom and Barbara])

Comment: Threats to the environment. Storing radioactive waste on-site has contaminated ground water at many reactor sites. After more than 40 years of commercial radioactive waste generation, there is no long term location to keep it safe and no way to recycle it. (**0041-3** [McMahon, John])

Comment: Storing radioactive waste on-site has contaminated ground water at many reactor sites. After more than 40 years of commercial radioactive waste generation, there is no long term location to keep it safe and contrary to many claims, no way to "recycle" it. Out of 104 US reactor sites, 100 have contaminated soil leading to contaminated ground water. Why will Lee be different? Nuclear waste remains radioactive for millions of years. There are currently 145 million tons of waste at 77 US sites. We can't afford to generate more nuclear waste!! (**0048-10** [Skeele, Michele and Skip])

Comment: [Building the W.S. Lee Nuclear Plant will:] Create radioactive waste that has to be stored locally because there is no long term storage solution. Currently there are 145 million tons of waste stored at 77 sites. Out of 104 nuclear plant sotrage sites, 100 have contaminated soil leading to contaminated ground water. We are leaving the problem of radioactive waste for generations to come. (**0112-5** [Andrews, Josephine] [Anonymous] [Beattie, Kathryn E.] [Boever, Virginia] [Boyle, Ella] [Brogan Prindle, Cathleen] [Davis, John] [Flores, S.] [Hamahan, Clare] [Keil, A. Eugene] [Leverette, Will] [Peterson, Harry] [Peterson, Martha J.] [Rittenberg, David] [Rustin, K.])

Comment: What will be done with the NUCLEAR WASTE remains a major argument against the Lee plant ever going forward. What happens to the ground water surrounding the plant, OR the fact that there is no long-term location to keep it safe or to "recycle" the waste? (**0133-7** [Christopher, Lucy D.])

Response: *Regarding the comments on contaminated soil and potentially contaminated groundwater, the Lee Nuclear Station site is a greenfield site without existing contamination. Therefore, what actions the applicant will take regarding radiological monitoring for such potential occurrences are discussed in Section 5.9.6 of the EIS as part of the impacts from normal operations. No change was made to the EIS as a result of the comments about potentially contaminated soil and groundwater.*

As presented in Section 6.1.6 of this EIS, current national policy, as found, for example, in the Nuclear Waste Policy Act (42 U.S.C. 10101 et seq.) mandates that high-level wastes (HLW) and transuranic wastes are to be buried at deep geologic repositories. The environmental impacts of spent fuel storage after the licensed life of operations for nuclear power plants are being *addressed through rulemakingand development of a generic EIS. Section 6.1.6 of this EIS has been revised to incorporate the proposed NRC rulemaking regarding the environmental impacts of continued storage of spent fuel.*

Comment: [Building the W.S. Lee Nuclear Plant will:] Increase uranium mining operations. Uranium fuel is not a renewable or clean source of energy. Mining not only affects the workers, it affects families as well. Mining releases radionuclide, radon, and other pollutants into streams. (**0004-8** [Cunningham, Kristine])

Comment: [We're opposed to the construction of all new nuclear reactors for many reasons:] ...generation of toxic radioactive waste and increased demand for fuel where mining has a massive record of health impacts on poor and indigenous communities. (**0012-7-3** [Hicks, Katie])

Comment: It uses uranium, which is not easily mined without permanent damage to miners and nearby communities. (**0013-13-4** [Bliss, Rachel])

Comment: What people tend to forget is that the mining and milling of uranium and then the transport of uranium is not an insignificant source of carbon emissions, not to mention the fact that it's tremendously for the people, mostly Native Americans on reservations in the southwest where uranium is mined in the United States, and that those nuclear tailings -- the radioactive uranium tailings pose a continued threat in that area. (**0013-32-1** [Holt, Cathy])

Comment: Uranium Mining: Uranium fuel is not a renewable or clean source of energy. Miners have been diagnosed with lung diseases, cancer. Uranium mining releases radon from the ground into the atmosphere. Mines and mining waste can release radionuclide, including radon and other pollutants to streams, springs, and other bodies of water. (**0017-8** [Morgan, Tom and Barbara])

Comment: ...and mining uranium is a very dangerous venture. (**0019-9** [Doebber, Tom])

Comment: ...and mining uranium is a very dangerous venture. (**0020-9** [Klein, Art and Michelle])

Comment: ...and mining uranium is a very dangerous venture. (**0026-7** [Doebber, Ian] [Doebber, Rachel])

Comment: Uranium mining has its dangers and quantity limitations. (**0046-6** [Southworth, Win])

Comment: The proposed plant does not make fiscal sense! Uranium fuel is not a renewable or clean source of energy. Miners have been diagnosed with lung diseases, cancer. Uranium mining releases radon from the ground into the atmosphere. Mines and mining waste can release radionuclide, including radon and other pollutants to streams, springs, and other bodies of water. (**0048-8** [Skeele, Michele and Skip])

Comment: Uranium mining: Miners have contracted lung diseases and cancer from this activity. (**0082-4** [Karpen, Leah R.])

Comment: It uses uranium which is not easily mined without permanent damage to miners and nearby communities. (**0104-10** [Bliss, Rachel])

Comment: [Building the W.S. Lee Nuclear Plant will:] Increase uranium mining operations. Uranium fuel is not a renewable or clean source of energy. Mining not only affects the workers, it affects families as well. Mining releases radionuclde, radon, and other pollutants into streams. (**0112-8** [Andrews, Josephine] [Anonymous] [Beattie, Kathryn E.] [Boever, Virginia] [Boyle, Ella] [Brogan Prindle, Cathleen] [Davis, John] [Flores, S.] [Hamahan, Clare] [Keil, A. Eugene] [Leverette, Will] [Peterson, Harry] [Peterson, Martha J.] [Rittenberg, David] [Rustin, K.])

Comment: Uranium mining: endangering lives of all mines & workers in / around the plant. (**0114-9** [Lovinsohn, Ruth])

Comment: Surely you know of the devastating effects on life of uranium mining? (**0121-4** [Wallace, Kristine])

Comment: I am also AGAINST URANIUM MINING - such as the one spoken of in Virginia - for the risk it impose on miners, and for the radon it releases in the atmosphere; and to streams, springs and other bodies of water. (**0133-5** [Christopher, Lucy D.])

Response: *Section 6.1 of the EIS discusses the environmental impacts for the uranium fuel cycle by applying Table S-3 of 10 CFR 51.51(a) (see Table 6-1 of the EIS) which assumed conventional underground and strip mining of uranium ore. The Table S-3 impacts were reviewed for their applicability to the current action before the NRC. The NRC staff review factored in the current mining practices, namely the increased reliance on in-situ leach mining for uranium. In-situ leach mining has fewer environmental impacts compared to underground and strip mining of the ore, especially with respect to past mining practices, because (1) workers are not exposed to radon gas for underground mining, (2) the dusty ore-crushing process is not needed and (3) management of the extensive waste tailings that are generated from underground and strip mining is not needed. All steps in the in-situ leach mining operation involve the uranium in a less dispersible liquid form. The result of the current practices is a much reduced health impact from past practices of several decades ago. Regardless of the form, mining operations must comply with the regulations of the Federal and/or State agency managing the land. The CWA and the Clean Air Act apply to all mining operations in the United States. Additional State and local environmental laws may also be applicable, depending on the location. No change was made to the EIS as a result of these comments.*

Comment: Nuclear contamination begins with the mining of the uranium, it goes through the processing of the uranium, the transportation, when it's used in the reactors, the storing of the nuclear waste, transporting it, and then dealing with the decommissioned reactors when it's all over. All along the line, even on the best of circumstances, there's going to be some leaking of radiation. (**0012-15-2** [Larsen Clark, Brita])

Comment: Nuclear energy is dangerous to people and the environment starting with the mining process through to the disposal of radioactive waste. (**0059-4** [Raleigh, Carolyn])

Comment: From the mining and refining of the uranium, through the operation of the plant, to the disposal of the *spent* but still highly radioactive fuel, there are dangers to human health and the health of the world we live in that are simply too great to justify. (**0079-2** [Schmitt, Brynn])

Response: *In Sections 6.1 and 6.2 of the EIS, the NRC staff evaluated the environmental impacts of the uranium fuel cycle. The NRC staff is confident that the contemporary fuel-cycle impacts are below those identified in Table S-3 of 10 CFR 51.51(a) (see Table 6-1 of the EIS). This is especially true in light of the recent fuel-cycle trends in the United States that change the manner in which uranium is mined, milled, and enriched with lower health impacts and energy consumption. Transportation of radioactive material must conform to the regulatory requirements of 10 CFR Part 71. Additional state and local environmental laws may also be applicable, depending on the location and the uranium fuel-cycle activity. No change was made to the EIS as a result of comments concerning the uranium fuel cycle excluding spent fuel and high level wastes.*

The environmental impacts of spent fuel storage after the licensed life of operations for nuclear power plants are being addressed through rulemaking and development of a generic EIS. Section 6.1.6 of this EIS has been revised to incorporate the proposed NRC rulemaking regarding the environmental impacts of continued storage of spent fuel.

Comment: The problem of building and maintaining a repository which provides absolute containment for the length of time it takes for radioactive materials to decay to a safe level. For example, Plutonium-239 has a half-life of 24,000 years. (**0119-7** [Thomas, Ruth])

Comment: I am a local resident who is being asked to pay for Duke Energy's environmentally irresponsible proposal. Below is my primary concern. Let us not only consider the present environmental impacts, but also the entire lifespan of the waste stream, which is considerable. It takes about 100,000 years for the nuclear waste to be safe enough for our environment. There are long-term underground holding sites, such as Onkalo in Finland. However, the unresolved issue of human interference over the course of the 100,000 years is their largest threat. According to Juhani Vira, the Sr. Vice President, Research of Onkalo, there is no found way to prevent people's curiosity or ignorance when Finnish or other current languages and symbols may become extinct by that vast length of time. A perfect example of this is the Egyptian pyramids, which were sealed ?permanently?, never to be interfered with. We are still not able to read all of the symbols and messages from certain lost civilizations. Vira states that it is safest to not leave any warning signs above the site, but to forget it in order to reduce the likelihood of interference. However, future societies may decide to unknowingly drill through the rock, as we do with wells today and as was have done as far back as the 16th century. Even though this catastrophe may not happen in our lifetime, it is a looming threat to the future environment of our children's children's children and so on. Plus, this example of Onkalo's underground holding facility only has the capacity for storing a fraction of the total approximately 250,000 tons of nuclear waste. With a need for more storage, there may eventually be several underground storage facilities, greatly increasing the danger of a breach of the holding facility. I feel that the NRC's Environmental Impact Statement does not adequately address the issue of long-term storage, as there is not currently a viable solution: ?there would be no on-site facilities for long-term storage or permanent disposal of solid wastes, so the packaged wastes would be temporarily stored in the auxiliary and radwaste buildings prior to being shipped to a licensed disposal facility (3-46).? However there is currently no permanent licensed disposal facility (in the United States), as stated by Andrew Kugler of the NRC. (**0131-1** [Apunte, Daya])

Comment: Let us not only consider the present environmental impacts, but its entire lifespan, which are inevitable. It takes about 100,000 years for the nuclear waste to make it safe enough for our environment. There are long-term holding sites, such as Onkalo in Finland. However, the unresolved issue of human interference over the course of 100,000 years is their largest threat. According to luhani Vira, the Sr. Vice President, Research of Onkalo, there is no found way to prevent people's curiosity or ignorance when Finnish or other current languages and symbols may become forgotten by that vast length of time. A perfect example of this is the Egyptian pyramids, which were sealed "permanently", never to be interfered with. We are still not able to read all of the symbols and messages from certain lost civilizations. Vira states that it is safest to not leave any warning signs, to forget it reduce the likelihood of interference. However, future societies may decide to unknowingly drill through the rock, as we do with wells today and as was done as far back as the 16th century. Even though this catastrophe may not happen in our lifetime, it is a looming threat to our future environment of our children's children's children and so on. Plus, this example of Onkalo's underground holding facility only has the capacity for storing a fraction of the total approximately 250 tons of nuclear waste, so there may eventually be several underground storage facilities, which would greatly increase the danger we impose on our environment (**0137-1** [Anonymous])

Response: *These comments concern the issue of disposal of spent fuel and other high-level radioactive wastes in a geologic repository. The ultimate disposal of spent fuel and high-level radioactive waste are discussed in Section 6.1.6 of the EIS. The current national policy, as found in the Nuclear Waste Policy Act (42 U.S.C. 10101 et seq.) mandates that the DOE eventually take control of spent fuel and transuranic wastes which would then be buried at deep geologic repositories. The EPA has responsibility to provide the environmental standards for a* *proposed high-level waste geologic repository. The NRC is responsible for conforming its regulations and guidance to those standards. On September 30, 2008, the EPA issued final standards for Yucca Mountain, requiring performance predictions for the period between 10,000 years and 1 million years after repository closure. On February 17, 2009, the Commission affirmed final regulations in 10 CFR Part 63 that conform to the EPA's final standards. No change was made to the EIS as a result of these comments.*

Comment: Nuclear wastes have been batted around without solution for as long as nuclear power has been around. We can put men on the Moon, but we cannot handle our nuclear wastes safely? It is not that hard. It requires only imagination and money. Nuclear wastes can be solidified into glass cylinders. The cylinders can be encased in concrete, and the concrete can been closed in military depleted Uranium from the wars in Iraq and Afghanistan, and formed into great torpedoes. Fins on the back end would cause the torpedo to rifle, and the front end would be formed as a self-tapping screw. These heavy objects could be barged to the Mariana Trench in the Pacific, where moving tectonic plates carry anything buried there towards the center of the Earth over millions of years. Released from the barge, the torpedoes would spin 6.8 miles to the bottom and bury themselves safely for the quarter of a million years that they remain dangerous to living things. Just do it and pay for it. (**0117-3** [Crissey, Brian])

Comment: The nuclear industry needs to stop relying on the U.S. taxpayer to foot its bill for handling nuclear wastes. The time is long overdue for the nuclear industry to stand on its own. Duke can responsibly bury all itsnuclear wastes in the Mariana Trench and just pay for it. (**0117-4** [Crissey, Brian])

Response: *The United States disposed of some radioactive waste at sea, before such practices were discontinued pursuant to U.S. environmental laws and regulations and international agreements designed to prevent marine pollution, such as the London Dumping Convention (NOAA 2013). The United States no longer disposes of radioactive waste in this manner, and although the option of permanent deep sea bed disposal was studied, the concept was abandoned. [DOE 2003] Current national policy, as found in the Nuclear Waste Policy Act (42 U.S.C. 10101 et seq.) mandates that high-level wastes and transuranic wastes are to be buried at a deep geologic repository. This act also created a funding mechanism to ensure that the full costs of disposing of commercial spent fuel would be paid by utilities (and their ratepayers), with no impact on taxpayers or the Federal budget. 10 CFR Part 60 and Part 63 provide the regulations on what the NRC can license for the long term disposal of spent nuclear fuel in geologic repositories. Burial in the Mariana Trench would not satisfy these regulations and would be in violation of international law on disposing of radioactive material in the oceans. No change was made to the EIS as a result of this comment.*

Comment: I just picked up -- and this is off my written comments -- the radioactive waste brochure that was outside, and under the NRC responsibilities it says the NRC is responsible for licensing and regulating the receipt and possession of high level waste, including spent fuel as well as reprocessing waste, at privately owned facilities -- and it goes on, but basically it says that they're going to take care, make sure that that waste is taken care of. In 1982, I believe it was, the act was passed in Congress to have a Nuclear Regulatory site -- or a DOE site -- excuse me -- that would take this waste. As of today, 30 years later, it still has not been built, and yet we are expected to sit back and say we trust you, we trust you to do it right, we trust you to listen to our complaints, we trust you to listen to our concerns, and we have lost the feeling that you do just that. (**0012-10-6** [Connolly, Mary Ellen])

Comment: And the uranium fuel cycle impacts included also transportation, decommissioning -- and I don't know whether there was anything else in there. But, I mean, the calculations. Now, this is -- their determinations on this were based on calculations, models, predictions. I couldn't see where they used any what I call real evidence of what had happened at places where they were exposed -- people were exposed and what levels it was and what caused it. And they came to the conclusion -- quote -- "The NRC staff," -- that's on page 6-5, Volume 1 -- "considered fuel cycle options." In other words, they -- in -- evaluated the one for -- the ones through with no reprocessing and the one where they would do reprocessing. Well, now, they did classify that spent nuclear fuel -- let's see -- after it was removed was considered radioactive -- highly radioactive waste. But they concluded -- this is another quote -- The no recycle option -- they would treat the waste and it would -- as radioactive waste and it would be stored at a federal repository. But there is no federal repository that exists. (**0012-3-1** [Thomas, Ruth])

Comment: Now, if these two units are built in Gaffney the waste that the two units would produce would be staying right there. I think they did predict that they might have another repository by 2038 or something like that. Oh, let's see. Well, for many years the answer to anybody who expressed concern about the radioactive waste was told, Oh, well, it's not a problem, it will be sent to Yucca Mountain in Nevada. That promise has proven to be a myth. (**0012-3-2** [Thomas, Ruth])

Response: *As presented in Section 6.1.6 of the EIS, current national policy, as found, for example, in the Nuclear Waste Policy Act (42 U.S.C. 10101 et seq.) mandates that HLW and transuranic wastes are to be buried at deep geologic repositories. The environmental impacts of spent fuel storage after the licensed life of operations for nuclear power plants are being addressed through rulemaking and development of a generic EIS. Section 6.1.6 of this EIS has been revised to incorporate the proposed NRC rulemaking regarding the environmental impacts of continued storage of spent fuel.*

Comment: A lot of people in this room have talked about nuclear waste. One of the things that people don't understand about the used nuclear material that comes out of our current basically second generation nuclear power plants is it comes out with about 95 percent of its potential stored energy still remaining. We don't have a waste problem, we have a resource that can be passed on to future generations. (**0012-12-1** [Adams, Rod])

Response: *Federal policy does not prohibit reprocessing; however, reprocessing is unlikely in the foreseeable future. Table S-3 from 10 CFR 51.51 does include impacts from reprocessing. In Section 6.1 of this EIS, the contributions in Table S-3 for reprocessing, waste management, and transportation of wastes are maximized for either of the two fuel cycles (uranium only and no-recycle); that is, the cycle that results in the greater impact is used. As discussed in this EIS, 10 CFR 51.51(a) allows the applicant to use Table S-3 as the basis for evaluating the contribution of the environmental effects of the uranium fuel cycle that includes reprocessing. Also presented in Section 6.1 of the EIS, during the 109th Congress, the Energy Policy Act of 2005 (42 U.S.C. 15801) was enacted. It authorized the DOE to conduct an advanced fuel recycling technology research and development program to evaluate proliferation-resistant fuel recycling and transmutation technologies that minimize environmental or public health and safety impacts. Consequently, while Federal policy does not prohibit reprocessing, additional governmental and commercial efforts would be needed before commercial reprocessing and recycling of spent fuel produced in the U.S. commercial nuclear power plants could begin. No changes were made to the EIS as a result of this comment.*

Comment: Have we learned nothing from Fukushima? Just the spent fuel rods stored at these facilities pose risks. With no storage facility and none in sight, we continue to play Russian Roulette with our future and the future of generations to come. (**0012-10-3** [Connolly, Mary Ellen])

Comment: How many years is it going to take to figure out what to do with the waste that's produced by these plants? It's not safe and it's not contained. I have asked many people, What do you do with the stuff when it leaves here? It goes to somebody else's backyard. I don't want it buried in my backyard -- metaphorically or literally. And you don't want it buried in your backyard. Why are we going to send even low-level waste to like Germany and Italy -- to another country or to the Southwest to bury it in tribal lands. We don't want to do this. We don't want to do this to their kids, and we don't want anybody to do it to our kids. The three arguments I've most heard for nuclear power are that the energy produced per amount of material is the highest that we know how to get at this point, the raw material and abundant, and the amount of waste is less than any other energy production -- means of energy production in large-scale use at this point. And what I have to say is that's not good enough. (**0013-9-1** [Tinnaro, Heather])

Comment: No one yet knows what to do with the spent fuel rods, so they are piling up on site, creating another problem for future generations to deal with. (**0063-6** [da Silva, Arjuna])

Comment: No one yet knows what to do with the spent fuel rods, so they are piling up on site, creating another problem for future generations to deal with. (**0076-4** [Anonymous])

Comment: I disagree that this project is safe for the ecology. Countless animals, plants, our water will definitely be threatened by a part of the plant ya'll don't even have to be concerned with the hazardous wastes! I fear that the waste materials will pose a dangerous challenge for generations to come. (**0086-3** [Rylander, Kimchi])

Comment: Potential release or leakage of waste material in transportation and storage--no disposal is possible, only storage (with half-life of waste being what it is, this will be a problem we are leaving for countless future generations) (**0116-3** [Schmitt, Daniel])

Comment: There is no safe way to dispose of or store the Radioactive waste. It's not fiar to future generations for us to pollute the Earth with Nuclear Waste that remains active for millions of years.
(**0139-2** [Dailey, Debbie])

Response: *These comments express concerns about spent fuel harming future generations. On January 26, 2012, the Blue Ribbon Commission on America's Nuclear Future (BRC) sent the Secretary of Energy its final report. The BRC provided recommendations on nuclear energy policy issues, including the storage, processing, and disposal of spent nuclear fuel. If the Secretary of Energy implements the recommendations of the BRC, any reprocessing or recycling program for spent fuel, on any significant scale, will not occur for many years. Appropriate NEPA reviews will be conducted by the NRC and/or DOE prior to the implementation of any recycling program for spent fuel. As presented in Section 6.1.6 of the EIS, current national policy, as found, for example, in the Nuclear Waste Policy Act (42 U.S.C. 10101 et seq.) mandates that HLW and transuranic wastes are to be buried at deep geologic repositories. The environmental impacts of spent fuel storage after the licensed life of operations for nuclear power plants are being addressed through rulemaking and development of a generic EIS. Section 6.1.6 of this EIS has been revised to incorporate the proposed NRC rulemaking regarding the environmental impacts of continued storage of spent fuel.*

Comment: Radioactive waste storage and disposal are ongoing concerns with existing and proposed nuclear power stations. The NRC approved final revisions to the Waste Confidence findings and regulation (10 CFR Part 51.23) in September 2010. The revision expresses the NRC's "confidence that the nation's spent nuclear fuel can be safely stored for at least 60 years beyond the licensed life of any reactor and that sufficient repository capacity will be available when necessary. " This refers to storage in a spent fuel basin or at either onsite or offsite independent spent fuel storage installations (ISFSIs), and eventual disposition in a repository. We are aware of the NRC's current proposal to extend onsite waste storage at nuclear power stations further into the future, assuming that no geologic repository becomes available for permanent disposition of this waste.

Since appropriate storage of spent fuel assemblies and other radioactive wastes are necessary to prevent environmental impacts, the Final EIS (FEIS) should provide a thorough consideration of impacts resulting from such storage. Given the uncertainty regarding ultimate disposal at a repository, on-site storage may continue for many years. (**0142-1** [Mueller, Heinz])

Comment: Also, EPA recommends that the FEIS include updated information about plans for radioactive waste storage and disposal... (**0142-2** [Mueller, Heinz])

Comment: *Radioactive Wastes*
Appropriate on-site storage of spent fuel assemblies and other radioactive waste is necessary to prevent environmental impacts. Plans include storage in a reactor's spent fuel basin, or at either onsite or offsite independent spent fuel storage installations (ISFSIs). Given the uncertainty regarding ultimate disposal at a repository, on-site storage may continue for along term, potentially hundreds of years, in relation to the Long-Term Waste Confidence Update currently under consideration by the NRC.

Yucca Mountain was formerly considered a possible final repository for spent nuclear fuel, but this plan was withdrawn by the U.S. Department of Energy by the motion of March 3, 2010. The abandonment of the plan to create a Yucca Mountain permanent geologic repository has been countered by NRC's Atomic Safety and Licensing Board. If another repository in the contiguous United States (other than Yucca Mountain) is ever selected, the environmental impact estimates from the transportation of spent reactor fuel to the repository should be calculated as required under 42 USC 4321 Fuel Cycle, Transportation, and Decommissioning.

In the Waste Confidence Rule (10 CFR 51.23), the Commission generically determined that the spent fuel generated by any reactor can be safely stored onsite for at least 30 years beyond the licensed operating life of the reactor. In a September 15, 2010 Decision and Rule, the NRC formally approved a final revision to its "Waste Confidence" findings and regulations. The revision expresses the NRC's "*confidence that the nation's spent nuclear fuel can be safely stored for at least 60 years beyond the licensed life of any reactor and that sufficient repository capacity will be available when necessary*. " The NRC made five findings:

1. Safe disposal in mined geologic repository is technically feasible.
2. At least one mined geologic repository will be available when necessary.
3. HLW (high level waste) and SNF (spent nuclear fuel) will be safely managed until a repository is available.
4. SNF can be stored safely and without significant environmental impacts for at least 60years beyond the licensed life.
5. Onsite or offsite storage for SNF will be made available if needed.

Recommendations: The FEIS should clarify the impact of this revision on the proposed project, as this new determination finds that spent nuclear fuel can be stored safely and securely without significant environmental impacts for at least 60 years after operation at any nuclear power station. EPA recommends that the FEIS cite any new analyses for longer-term storage regarding scientific knowledge relating to spent fuel storage and disposal. The FEIS should also mention any developments with the Presidential Blue Ribbon Commission on alternatives for dealing with high-level radioactive waste, if updates occur before FEIS publication.

EPA recommends discussion of the construction of the ISFSIs in the final EIS. The final EIS should include a more detailed description of the radioactive waste storage facility. (**0142-5** [Mueller, Heinz])

Response: *These comments by the EPA concern the environmental impacts of spent fuel presented in Section 6.1.6 of the EIS. Current national policy, as found, for example, in the Nuclear Waste Policy Act (42 U.S.C. 10101 et seq.) mandates that HLW and transuranic wastes are to be buried at deep geologic repositories. If the DOE selects and submits an application for an NRC license of another repository in the contiguous United States (other than Yucca Mountain), the NRC expects that a new repository application would include environmental impacts from the transportation of spent fuel specifically tied to the time and location of the action. The applicant does not have plans at this time to construct and operate an independent spent fuel storage installation (ISFSI) and will rely on the available internal capacity to store spent fuel provided by the AP1000 certified design. Whether an ISFSI at the Lee Nuclear Station site eventually would be necessary depends on the future actions of the DOE. If a COL is granted by the NRC under this action and Duke applies at a future time for an ISFSI license at the Lee Nuclear Station site, the appropriate assessment of the environmental impacts related to that ISFSI licensing action would developed in accordance with NRC regulations. The environmental impacts of spent fuel storage after the licensed life of operations for nuclear power plants are being addressed through rulemaking and development of a generic EIS. Section 6.1.6 of this EIS has been revised to incorporate the proposed NRC rulemaking regarding the environmental impacts of continued storage of spent fuel.*

Comment: I contend that toxic waste should not be stored in somebody else's backyard. Keep the toxic waste where it is created. Implement HOSS, which is hardened on- site storage, and keep toxic nuclear waste at its source. (**0012-19-3** [Howarth, Irma])

Comment: I contend that toxic waste should not be stored in someone else's back yard!! Keep the toxic waste where it is created! Implement HOSS, Hardened On-Site Storage & keep toxic nuclear waste at it's source. (**0092-4** [Howarth, Irma])

Response: *These comments concern the national policy for the disposal of spent fuel. As presented in Section 6.1.6 of the EIS, the current national policy, as found in the Nuclear Waste Policy Act (42 U.S.C. 10101 et seq.) mandates that the DOE eventually take control of spent fuel and transuranic wastes which would then be buried at a deep geologic repository. The environmental impacts of spent fuel storage after the licensed life of operations for nuclear power plants are being addressed through rulemaking and development of a generic EIS. Section 6.1.6 of this EIS has been revised to incorporate the proposed NRC rulemaking regarding the environmental impacts of continued storage of spent fuel.*

Comment: I think that the reactive waste is a problem that no states wants to store because of its toxic nature to people and other organisms. (**0022-1** [Sloss, Barbara])

Comment: Nuclear waste remains radioactive for millions of years. (**0041-5** [McMahon, John])

Comment: ...and the waste that it creates has been proven to be irreparably toxic to humans and habitat. (**0056-4** [Rhyne, Faith Rachel])

Comment: No more 'Nuclear' Plants should EVER be built with the risk knowledge that just the by product of 'Nuclear' being nuclear waste, has been defined as "POISON" to people, plants and any life form on this planet, and should not be produced day after day, month after month, year after year, and piled up somewhere or anywhere. (**0077-1** [Gilbert, Grace])

Comment: Stacks and stacks of extremely dangerous Poison stored, a time bomb set to strike and no defense available. (**0077-2** [Gilbert, Grace])

Comment: As a citizen of Western North Carolina, I and my friends find this a very frightening proposition. We are not very comfortable with the thought of nuclear waste being stored within 60 miles of our homes. We know that it lasts for millions of years & that there is no safe way to store it. (**0115-2** [Burnett, Linda])

Response: *These comments concern the environmental impacts of onsite storage and eventual disposal of low-level radioactive waste (LLW), spent fuel, and high-level radioactive waste likely to be produced by the proposed Lee Nuclear Station. Section 5.9 of the EIS evaluates the radiological impacts of operation of proposed Lee Nuclear Station, including the onsite storage of radioactive wastes until they can be shipped to a licensed waste disposal facility. Section 6.1 of the EIS addresses the environmental impacts of the fuel cycle, and Section 6.1.6 specifically addresses the environmental impacts of radioactive waste disposal after it is shipped from the site. For LLW, the impacts are related to near-surface disposal like that currently provided by Energy Solutions Inc. at the Class A LLW disposal facility near Clive, Utah and Waste Control Specialist, Inc. in Andrews County, Texas for Classes A, B, and C LLW. Section 6.1.6 also addresses options such as the addition of temporary onsite storage capacity if licensed disposal facilities are temporarily not available. As presented in Section 6.1.6 of this EIS, current national policy, as found, for example, in the Nuclear Waste Policy Act (42 U.S.C. 10101 et seq.), mandates that HLW and transuranic wastes which would then be buried at deep geologic repositories. The environmental impacts of spent fuel storage after the licensed life of operations for nuclear power plants are being addressed through rulemaking and development of a generic EIS. Section 6.1.6 of this EIS has been revised to incorporate the proposed NRC rulemaking regarding the environmental impacts of continued storage of spent fuel.*

Comment: I happen to have the access information as to what the Navy, which has been operating nuclear powered ships for 50 years, does with its used nuclear fuel. It takes it to a place in Idaho in the desert and stores all of the used nuclear fuel from all of the ships and submarines that have been powered by nuclear energy in one place. That one place is smaller than this room. If you took all of the commercial nuclear fuel that the U.S. has been producing in 104 reactors that have been providing 20 percent of our electricity for the last 20 years and before that supplied a little bit less as we were building up, you could put all that commercial fuel in the size of one Super Walmart, one Super Walmart. (**0012-12-4** [Adams, Rod])

Comment: There is no long-term solution for disposal of radioactive waste from nuclear power plants. Personally, I'm not opposed to research addressing this topic. Until there is a long-term solution for disposal of radioactive waste from nuclear power plants, I'm hoping we give high priority to not building additional nuclear power plants. (**0012-6-1** [Gilman, Steve])

Comment: Whereas there is no safe way to dispose of high-level radioactive waste. (**0013-11-4** [Smith, Coleman])

Comment: We still cannot adequately deal with nuclear waste... (**0013-13-5** [Bliss, Rachel])

Comment: And also how can a technology that creates waste material that will last for millions of years -- how can this ever been environmentally sound? There's no safe way to store it, and what community wants to have it passing through their town? (**0013-19-3** [Dailey, Debbie])

Comment: And one of the biggest problems that I want to address is the waste. There is currently no repository for high-level nuclear waste in this country. The people that build the plant and the NRC are not responsible for ultimately deciding and taking responsibility for what to do with the high-level nuclear waste. All they can do is keep it on site until the Department of Energy decides they know where to put it and does something. Now, this stuff has half-lives. This stuff lasts thousands of years. Some has a half-life of a couple of days; some has a half-life of hundreds and hundreds of years. That only means half of it's gone; the rest of it's still there. If I kept my garbage on my property and hoped somebody else would come and take it away some day, my neighbors would have a problem and it's not even toxic. I'm your neighbor. I have a problem with this. Until nuclear industry can figure out what to do with the waste it's totally irresponsible to generate it. (**0013-26-3** [Sloan, Judie])

Comment: ...plus all the dangers of nuclear waster storage and the shipping of nuclear waste on highways we feel that the risks are too great. (**0014-2** [Wilson, Rev. Mason and Barbara S.])

Comment: Besides the risk of a calamity, nuclear waste storage continues to be a major problem... (**0019-8** [Doebber, Tom])

Comment: Besides the risk of a calamity, nuclear waste storage continues to be a major problem... (**0020-8** [Klein, Art and Michelle])

Comment: [Before acting on this proposal, adequate AND PUBLIC review should include:] Acceptable plan for management and disposition of the spent fuel... (**0021-2** [Rinsler, MD, Steve])

Comment: Nuclear power leaves waste impossible to dispose of and dangerous to transport. (**0024-2** [Whitefield, Anne])

Comment: Besides the risk of a calamity, nuclear waste storage continues to be a major problem... (**0026-6** [Doebber, Ian] [Doebber, Rachel])

Comment: Nuclear power is non-renewable, and the spent fuel storage issues are insane. (**0037-2** [Collins, Richard])

Comment: We have no long-term solution to the question of what to do with radioactive nuclear waste. (**0039-4** [Whiteside, Cassie])

Comment: We have no long-term solution to the question of what to do with radioactive nuclear waste. (**0043-4** [Reeser, Rachel])

Comment: ....not to mention the issues with storage and disposal of waste. (**0044-2** [Bertram, Beth])

Comment: Nuclear waste is a growing problem and potential threat. (**0046-7** [Southworth, Win])

Comment: My position [opposition] is based on... The inherent DANGERS of nuclear waste, which projects already on line Have just not been able to protect against or solve. (**0047-4** [Lauden, Loy])

Comment: And even if it were, there has been no SAFE plan developed on what to do with the nuclear waste from nuclear power plants. (**0051-3** [Oehler, Susan])

Comment: How can we fail to recognize that finding a safe and reasonable solution to the problems of managing radioactive waste is not available despite the recommendations of the Blue Ribbon Commission? (**0058-5** [Patrie, MD, MPH, Lewis E.])

Comment: Nuclear waste: No one has yet figured out how safely to dispose of such waste. (**0082-5** [Karpen, Leah R.])

Comment: [There are many other decisive reasons to stop the proposed plant...] ...not to mention our inability to find safe long-term storage for the radioactive waste. (**0083-9** [Broadhead, Susan])

Comment: There is NO SAFE DISPOSAL OF WASTE!!! (**0085-5** [Allison, Patricia])

Comment: I am concerned about the safety & health effects from toxic nuclear waste. (**0092-1** [Howarth, Irma])

Comment: ...not to mention our inability to find safe long-term storage for the radioactive waste. (**0098-8** [Broadhead, Susan])

Comment: We still cannot adequately deal with nuclear wastes... (**0104-11** [Bliss, Rachel])

Comment: The nuclear waste cannot be dealt with in any good way. (**0107-3** [Acs, Deborah])

Comment: Storage of the spent fuel is a continuing problem, one that nobody has found a good solution to. (**0113-4** [Rose, Katherine])

Comment: We CANNOT HANDLE EXISTING NUCLEAR WASTE let alone produce more. (**0114-3** [Lovinsohn, Ruth])

Comment: The problem of highly radioactive spent nuclear fuel having to be stored onsite because there is no safe repository. (**0119-8** [Thomas, Ruth])

Comment: It has been decades since nuclear power was introduced in the USA and even after all this time no effective program has been developed to deal with the radioactive waste. It seems to be a very poor business decision to proceed with more nuclear plants without effective waste management. (**0120-2** [Wilson, Dawn])

Comment: ...and nuclear waste that cannot be safely disposed of. Where would this waste go? Surely you know that it remains toxic practically forever? (**0121-2** [Wallace, Kristine])

Comment: Waste disposal - To date we do not have a source of long term safe disposal/storage. (**0122-3** [Justice, Cynthia and Michael])

Comment: Furthermore, there remains no good solution to storage of spent fuel. (**0124-3** [Hayes, MD, J. David])

Response: *These comments are concerned with the development and implementation a national program to safely dispose of the Nation's nuclear waste. For LLW, Section 6.1.6 of the EIS discusses the near-surface disposal facilities organized under regional LLW management compacts. In particular, the Energy Solutions Inc. disposal facility in Barnwell, South Carolina in the Southeast Compact would serve the Lee Nuclear Station until 2038. Also presented in Section 6.1.6, current national policy, as found, for example, in the Nuclear Waste Policy Act [NWPA] (42 U.S.C. 10101 et seq.) mandates that HLW and transuranic wastes are to be buried at deep geologic repositories. The environmental impacts of spent fuel storage after the licensed life of operations for nuclear power plants are being addressed through rulemaking and development of a generic EIS. Section 6.1.6 of this EIS has been revised to incorporate the proposed NRC rulemaking regarding the environmental impacts of continued storage of spent fuel.*

E.2.18 Comments Concerning Transportation

Comment: Transporting nuclear waste on our highways to deposit it at some unknown repository or recycling site and hauling those toxic dangerous wastes on our highways is frightening and not safe. Currently used to transport by truck are rail are the unsafe nuclear waste shipping casks that emit neutron and gamma radiation as they travel through cities and other populated areas, and are more prone to accidents as they travel thousands of miles and also on our curvy mountain roads. (**0012-19-2** [Howarth, Irma])

Comment: Transporting toxic nuclear waste on our highways to deposit it at some unknown repository or recycling site & hauling these toxic, dangerous waste on our highways is frightening & not safe. Currently used to transport by truck or rail are the unsafe nuclear waste shipping casks that emits neutron & gamma radiation & are more prone to accidents at they travel our curvy mountain roads. (**0092-3** [Howarth, Irma])

Comment: The problem of providing containment during transport of radioactive materials. For example, an accident on I-85 would result in the total disruption of access from Atlanta to Greenville/Spartanburg to Charlotte. If there were an accident, all tourism and jobs in the surrounding area would cease, and everyone that lives in close proximity would have to have their food and basic necessities imported, or else leave.
(**0119-9** [Thomas, Ruth])

Response: *Transportation of spent fuel is discussed in Section 6.2.2 of the EIS. The NRC has conducted several transportation studies to evaluate the risks associated with transporting radioactive material. The NRC (1977b) issued NUREG-0170, "Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes," in December 1977 to support its rulemaking set forth in 10 CFR Part 71, "Packaging and Transportation of Radioactive Material." Based on this study, the NRC concluded that the transportation regulations are adequate to protect the public against unreasonable risks from the transport of radioactive materials, including spent fuel. The NRC (1987) sponsored another study, NUREG/CR-4829, "Shipping Container Response to Severe Highway and Railway Accident Conditions," issued February 1987, known as the "Modal Study." Based on the results of this study, the NRC staff concluded that NUREG-0170 overestimated spent fuel accident risks by about a factor of three. The NRC (2000b) initiated another spent fuel study, issued as NUREG/CR-6672, "Reexamination of Spent Fuel Shipment Risk Estimates," in March 2000. This study focused on the risks of a modern spent fuel transport campaign from reactor sites to possible interim storage sites and/or permanent geologic repositories. This study concluded that risks from accidents were much less than those estimated in NUREG-0170 and that more than 99 percent of transportation accidents are not severe enough to impair the function of the NRC-certified spent fuel package. While very severe accidents could cause damage the package, the studies show that any release of material would be very small and pose little risk to the local population/public. No changes were made to the EIS as a result of these comments.*

E.2.19 Comments Concerning Cumulative Impacts

Comment: Indirect and Cumulative Impacts
In a project of this magnitude, there is a potential for significant indirect and cumulative impacts to important resources. The DEIS notes that air quality, water resources, habitat, farmland, historic and archaeological resources are particular areas of concern that may be subject to indirect and cumulative impacts. In addition, EPA recommends further consideration of the project's indirect and cumulative impacts related to socioeconomic resources and EJ communities.

Recommendations: We appreciate the information in the DEIS regarding your coordination with resource agencies regarding mitigation planning for ecological, cultural and historical resource impacts, and we recommend that continuing coordination take place as the project proceeds in order to minimize direct, indirect and cumulative impacts.
(**0142-25** [Mueller, Heinz])

Response: *The USACE will continue to coordinate with Federal- and State-resource agencies regarding proposed mitigation for both ecological and cultural and historic resource impacts. The USACE is working closely with the EPA, the FWS, the U.S. Forest Service, the SCDNR, and the SCDHEC to guide Duke toward finalizing the project's Section 404 permit application mitigation plan. This coordination will continue through the implementation and eventual monitoring of the planned mitigation. In addition, the USACE was the lead agency for coordinating the implementation of the joint cultural resources management plan and memorandum of agreement between the USACE, Duke, and the SC SHPO. Though some coordination between Duke and Cherokee County has occurred, the NRC does not have the authority to require continuing coordination with respect to socioeconomics and environmental justice. No changes were made to the EIS as a result of this comment.*

E.2.20 Comments Concerning the Need for Power

Comment: We spoke earlier about growth. In the 2010 census South Carolina grew by about 15-plus percent, Cherokee County grew by 5 percent, and York County which is just right across the Broad River, grew by 37 percent. This influx in population necessitates additional power sources to meet those people's residential needs and also to meet industry's needs, so the nuclear plant would provide those sources. (**0012-14-2** [Boger, Paul])

Comment: If for no other reason than national security, we will need to provide a viable and immediate solution to what could be a pending crisis of increasing electricity demand. The recent financial fiasco will pale in comparison to the economic impact if we're unable to meet the future energy demands. (**0012-16-3** [Farris, Mark])

Comment: Whereas, demand for electricity for the state of South Carolina is growing and is in our best interest for South Carolina utilities to produce the needed electricity in our state through the development of new nuclear power plants. (**0013-1-2** [Moss, Representative Dennis])

Response: *In general, the comments support the discussion provided in Chapter 8 of the EIS regarding the need for power. No changes to the EIS were made as a result of these comments.*

Comment: Many of you know that Duke uses a very comprehensive, integrated planning approach to ensure we can continue to safely and reliably meet the electricity needs for our customers, both now and in the future. The integrated planning considers many variables, including projected energy use, existing generation resources and planned retirement, energy efficiency. So I was speaking about the integrated approach that we use. This planning approach considers many variables, including projected energy use, existing generation resources and planned retirements, energy efficiency and the addition of new generation, including renewable resources. We're fortunate to have a diverse portfolio of generation stations with nuclear, of course, serves as a part of that fuel mix in the Carolinas for over or nearly 40 years. Many of you know that we operate five stations in the State of South Carolina, five units in the State of the South Carolina. Two of the units are the Catawba units in York County, South Carolina and three of the units are the Oconee Nuclear Station, which is the Oconee County of South Carolina. These two stations, along with two other units, the McGuire units in North Carolina, provide approximately half of the electricity used by our customers in the Carolinas and have collectively generated more than 1.5 billion megawatt hours of electricity since they've started operation. Let me pause and tell you just briefly about the performance of those assets. Our nuclear capacity factor in 2011 was approximately 93 percent, making 2011 the 12th consecutive year our capacity factor was more than 90 percent. For those of you not familiar with the term, capacity factor is units of reliability. It's basically the amount of electricity generated from a unit or a facility compared to the amount of electricity that can be generated if the unit was operating all the time. As part of our plan to serve our customers' future electricity need it's important that we make sound decisions now on their behalf. This includes our decision to submit a combined construction and operating license application to the NRC for the Lee station and to continue project development activities. The units planned for Lee Nuclear will have a combined output of more than 2,200 megawatts, enough generation to reliably serve thousands of homes for decades. (**0012-2-1** [Jamil, Dhiaa])

Response: *The comments support the discussion in Chapter 8 and Section 9.2 of the EIS regarding alternative energy resources including energy efficiency and renewable energy. No changes to the EIS were made as a result of this comment.*

Comment: Nuclear power is the most viable and affordable bridge to energy independence for South Carolina and the region. The business community understands the need of expanded energy capacity in the state as population continues to grow in South Carolina and across the southeast. Energy costs represents one of the highest costs of businesses on a daily basis. The availability of energy is at the cornerstone of many of our businesses' success. It is estimated between now and 2025, the Palmetto State's population will increase by more than a million people. Anticipated growth around the Port of Charleston, with the increase in distribution facilities and big boxes and the increased population growth will result in an estimated need of 5,000 megawatts of energy by 2025. If we continue pressing forward with the energy we have today, our resources will not be sufficient to shoulder the increased demand. Current statistics show our state energy reserve margins are shrinking each year. If not addressed, they are positioned to place the state at a huge economic disadvantage as early as 2014. (**0012-5-2** [Rawl, Otis])

Comment: And now because of forecasted need -- and by the way, that need forecasted not just by Duke Energy but by my members, the manufacturers, that will provide the best jobs in South Carolina -- because of forecasted need, we've got to make decisions again, and we believe nuclear energy is a good way to do that. (**0012-9-2** [Gossett, Lewis])

Comment: In order to see the kind of expansion and growth we're going to want to see in the manufacturing base in South Carolina, we've got to have new capacity, and this is the best way, in our minds, to have that. (**0012-9-4** [Gossett, Lewis])

Comment: Nuclear energy is a vital part of America's energy portfolio. Nuclear energy currently produces electricity for one in every five homes and businesses in the United States and accounts for about 50 percent of the energy for Duke Energy Carolinas' customers. As we look to the future and how we will continue to meet our future needs of our customers we will continue to rely on a diverse energy portfolio that includes nuclear energy, which is the only baseload energy resource that can produce electricity 24 hours a day, seven days a week without emitting any greenhouse gases. (**0013-4-1** [Fallon, Chris])

Response: *The NRC does not establish public policy regarding electric power supply alternatives, nor does it promote the use of nuclear power as a preferred energy alternative. Decisions regarding which generation resources and energy alternatives to generation to deploy were made by the applicant through least-cost planning and integrated resource planning. The comment generally supports the discussion regarding the need for power found in Chapter 8 and Chapter 9.2 including aspects of the growth in demand for energy, reserve margin analysis, generating resources, and alternatives to energy resources. No changes were made to the EIS as a result of the comment.*

Comment: The good news is over the past year, two, maybe going back as far as into 2009, my members have started to rebuild and started to reinvest, and they've got ideas about continuing to do that, but I can assure you that one of -- if not the key -- factors in their decision-making process is reliable, affordable energy. Got to have abundant energy in order to do it. And my members have made those assessments. They make those assessments every time they make economic development decisions, and I get to be in a lot of those meetings. My friend, Otis Rawl, of the state Chamber does as well. We know, importantly, why South Carolina wins projects, and just as importantly, we know why South Carolina loses projects, and believe me, Duke Energy's provision of power to the upstate has been a key, if not the key, component to the growth of manufacturing in this area. (**0012-9-1** [Gossett, Lewis])

Response: *In general, the comment supports the need for power discussion in Chapter 8, which includes discussion about State directives for franchised service territories, and the requirements to supply power that meets tests for reliability and economics. No changes to the EIS were made as a result of this comment.*

Comment: The reactor is not needed nor cost effective. (**0052-2** [Boots, Debby])

Response: *The need for power is described in Chapter 8. The economic decision made by the applicant to pursue licensing is outside the scope of the environmental review. Tests of reliability and cost-effectiveness are governed by the respective States in which the applicant operates and sells power into, and is reflective of business decisions over which the NRC has no regulatory control. No changes were made to EIS as a result of the comment.*

Comment: Section 1.3.1, Page 1-11, Lines 15-16: The demand for the year 2026 increases to 5176 MW(e) in the 2011 IRP provided to NRC in the September 15, 2011 letter WLG2011-09-04. (**0134-3** [Fallon, Chris])

Comment: Section 8.1.4, Page 8-10, Line 8: The Duke Energy 2010 annual Integrated Resource Plan (IRP) was approved by the North Carolina Utilities Commission on October 26, 2011. The South Carolina Public Service Commission publicly vetted and heard testimony regarding the 2010 IRP on November 9, 2010. (**0134-67** [Fallon, Chris])

Comment: Section 8.1.4, Page 8-10, Line 8: Duke Energy provided the 2011 annual Integrated Resource Plan to the South Carolina Public Service Commission (Docket No. 2011-10-E) on September 1, 2011, the North Carolina Utilities Commission (Docket No. E-100 Sub 128) on September 1, 2011, and the Nuclear Regulatory Commission (Accession No. ML11262A205) on September 15, 2011. (**0134-68** [Fallon, Chris])

Response: *The need for power evaluation completed for the EIS was based on the applicant's 2012 IRP; State approval of the IRP forecast methodologies, specifics regarding resource management, and results of the power and energy forecast are relevant to the findings presented in the EIS. The EIS was changed to reflect recent changes to the projected supply and demand for electricity but retains the draft's earlier discussions of (1) the review and approval of the 2010 IRP by the North Carolina Utilities Commission on October 26, 2011; and (2) public review and testimony addressing the 2010 IRP by the Public Service Commission of South Carolina on November 9, 2010.*

E.2.21 Comments Concerning Energy Alternatives

Comment: Please say NO and ask for proposals of renewable energy. (**0001-5** [Stoll, Irene])

Comment: We need to focus on solar and wind energy as well as energy use reductions. (**0003-3** [Arnold, Debbie])

Comment: I would rather see this money go into incentive programs for people to install solar, wind, or geothermal systems and into education about conservation. (**0005-2** [Lewis, Brenda K.])

Comment: We need to concentrate on renewable energy, not dirty expensive energy. (**0006-2** [Flaherty, David])

Comment: [Before acting on this proposal, adequate AND PUBLIC review should include:] Alternative approaches to provide additional energy that don't involve the use of nuclear fuel, specifically including non-fossil fuel approaches (wind, solar, hydro, etc). (**0021-3** [Rinsler, MD, Steve])

Comment: Solar, tidal, geothermal and wind power are clean and harmless. (**0024-3** [Whitefield, Anne])

Comment: I am convinced that our government has the financial resources, intelligence and imagination to find alternative energy sources that do not create the risk involved in Nuclear Energy. We have the potential to lead the world in clean energy technology and ingenuity. (**0025-3** [Dixon, Mary])

Comment: Put your money and research into safer, more reasonable renewable energy sources and negotiate for more subsides from the government for these alternative energies and then they might actually happen. Germany has been able to turn this around, why not the US, too. (**0027-5** [Nord, Felice])

Comment: Why are we not pursuing a national campaign for energy conservation, so there is no longer a call for an increase in energy sources? Why are we not robustly encouraging innovation in renewable energy technologies? (**0029-2** [Scott, Cathy])

Comment: We have many other options which are clean and renewable--like wind, solar, geothermal, etc. (**0039-1** [Whiteside, Cassie])

Comment: Nuclear power is not a clean and renewable energy. We have many other options which are clean and renewable--like wind, solar, geothermal, etc. (**0043-1** [Reeser, Rachel])

Comment: The wise choice for the US is to make the same commitments to renewable sources, and NOT build any more nuclear plants. (**0044-3** [Bertram, Beth])

Comment: I believe we should invest our resources in clean, renewable energy systems such as solar! (**0048-9** [Skeele, Michele and Skip])

Comment: Nuclear power is not clean, it is not renewable... (**0056-3** [Rhyne, Faith Rachel])

Comment: There are plenty of alternatives to supply the Upstate region with clean, renewable energy. (**0056-5** [Rhyne, Faith Rachel])

Comment: Such alternatives include reducing the current waste and inefficiency of electricity usage, and solar, wind and other truly renewable sources of electrical power. (**0058-2** [Patrie, MD, MPH, Lewis E.])

Comment: Would not our decision makers better decide to instead move forward by investing in energy efficiency, conservation and clean renewable energy? (**0058-6** [Patrie, MD, MPH, Lewis E.])

Comment: I support energy conservation, efficiency, and safe, renewable energy sources and want to see these promoted instead. (**0059-2** [Raleigh, Carolyn])

Comment: And there are safe, renewable energy sources available for LESS cost to the pocketbook and the environment, not to mention simple smart conservation. (**0061-4** [Holt, Cathy])

Comment: Please look to alternative and safe energy for future generations. (**0062-3** [Smith, Joy])

Comment: ...and encourage the development of viable alternatives. (**0063-3** [da Silva, Arjuna])

Comment: The power companies should phase out existing nuclear facilities and invest in localized, safe, clean, renewable sources, and encourage the public to conserve power and to employ new technology to reduce the draw from the power grid. (**0063-8** [da Silva, Arjuna])

Comment: ...invest in localized, safe, clean, renewable sources, and encourage the public to conserve power and to employ new technology to reduce the draw from the power grid. (**0076-7** [Anonymous])

Comment: I think it would be far better to have each building, business or home installed with a separate power source either maintained by "the big power company' or the owner. Using solar, renewable, wind, a power source that is uniquely correct and safe for each building. (**0077-4** [Gilbert, Grace])

Comment: Now's the time for conservation and developing renewables and efficient use of existing and soon to be available green sources. (**0078-3** [Atanasoff, Mike])

Comment: ...we need to put all available funds into the development of alternative energy! (**0081-2** [Severin, Patricia])

Comment: We MUST spend our creativity and money on perfecting carbon-free, nuclear-free energy systems which feed into and tap into a smart grid, where people can install solar panels or windmills at their homes or businesses and feed excess energy into the smart-grid. (**0089-4** [Thomas, Ellen])

Comment: Support viable, sustainable & clean alternatives that also create many more permanent jobs. (**0092-6** [Howarth, Irma])

Comment: Let's shift to safe renewables: wind, solar. It can be done, let's do it. (**0105-1** [Craig, Anne])

Comment: Please abandon dangerous nuclear technology and instead fund truly green energy sources we can live with. (**0106-2** [Hearne, Ray])

Comment: Now and going forward America and the world must spend our funds on Green, truly clean energy. (**0107-1** [Acs, Deborah])

Comment: I give 100 percent approval to wind power as a source of energy. (**0110-2** [Genetti, Phyllis])

Comment: There are other alternatives to nuclear power, so much more humane, that we should be focusing on. (**0113-5** [Rose, Katherine])

Comment: There are safe, renewable, clean energy sources / technologies available. (**0114-12** [Lovinsohn, Ruth])

Comment: I am in favor of using that money to finance safe, reliable reusables. (**0115-4** [Burnett, Linda])

Comment: Drop the nuclear option and invest in energy efficiency and renewables. (**0117-11** [Crissey, Brian])

Comment: We must pursue other energy solutions such as wind and solar. (**0121-6** [Wallace, Kristine])

Comment: Our resources are put to much better use by pursuing clean, renewable sources of energy. (**0124-4** [Hayes, MD, J. David])

Response: *These comments express general support for renewable energy sources and conservation/energy efficiency, and a belief that funds would be better spent on renewable energy. Renewable energy sources and their ability to meet the purpose and need of the* *project were evaluated in Section 9.2 of the EIS, and none of the alternatives mentioned in the comments were determined to be both capable of meeting the purpose and need for the project and environmentally preferable. In accordance with NRC guidance for the review of energy alternatives, the cost of an alternative is only considered if the alternative is environmentally preferable, Because none of the competitive alternatives was environmentally preferable, the issue of cost was not considered. No changes were made to the EIS in response to these comments.*

Comment: Finally, building W.S. Lee nuclear power plant is unnecessary because the cost of wind energy is now below the cost of nuclear energy. Renewable energy options don't pose a radiation hazard to the public and the environment. (**0004-11** [Cunningham, Kristine])

Comment: There are other, cleaner sources of power that do not leave permanent and potentially lethal scars on our environment, our families, and our children. (**0007-2** [Tinnaro, Heather])

Comment: The handwriting is clearly on the wall. Either turn away from nuclear and toward conservation, efficiency, and safe renewable energy production or turn out planet into an increasingly radioactive, cancer generating, lung disease producing, toxic world. (**0013-20-5** [Craig, Anne])

Comment: If we spend $14 billion on this nuclear power plant that is $14 billion less that we will have to spend on alternative energy. It seems to me that we are engaging in an incredibly dangerous experiment with the future of our children, grandchildren, great grandchildren, and our students and lots of others. Let's do an experiment -- a $14 billion experiment with alternative energy -- with solar, wind, and geothermal -- rather than doing a $14 billion experiment with things that we know are dangerous. (**0013-21-1** [Norris, Steve])

Comment: My request is to implement a balanced solution -- to move away from nuclear and coal and aggressively adopt renewable energy solutions for businesses and families. South Carolina needs a diverse, balanced energy portfolio in which utilities are required to support renewable resources and move towards a balanced distribution of energy. Solar, wind, and water energy sources should be encouraged through strong incentives and promoted as another viable local energy option so the strain and consumption from one energy source is not so strongly felt. We are running out of time and continue to destroy our precious land and water resources. By implementing a balanced energy solution we can begin to be less dependent on destructive, toxic form of energy. (**0013-36-1** [Cranford, Kelley])

Comment: These billions of dollars should be used for solar or wind energy that does not increase the risk of nuclear meltdowns, contaminate the water, or generate nuclear waste that will poison the ground for millions of years. (**0030-7** [Swing, Carol])

Comment: While knowing that energy alternatives are necessary, perhaps we should look to more benign sources such as solar to meet our needs. (**0034-2** [Gardner, Janet])

Comment: I realize only too well the difficulties of our energy usage and future needs. Much can be accomplished with various modes of energy conservation and the evolving technologies of sustainable, renewal energy sources. And, given time and much work, I sincerely believe we shall no longer need to rely on polluting nonrenewables and massively expensive and life-threatening sources such as our currently configured nuclear power stations. (**0046-1** [Southworth, Win])

Comment: My position [opposition] is based on... The opportunity to ADVANCE RENEWABLE AVENUES of ENERGY And sane steps toward energy management HAVE NOT BEEN SUFFIENTLY UNDERTAKEN BEFORE deferring to this Hazardous and potentially unsustainable course. (**0047-6** [Lauden, Loy])

Comment: The public demands alternative energy that is guaranteed safe. Please try looking at the sun and wind and cease digging underneath the ground and mixing up unpredictable chemicals (**0052-4** [Boots, Debby])

Comment: The irony of this proposed toxic nuclear plant is that increased efficiency and downscaling of power usage could render it unnecessary at present. For future needs, I believe that we should develop and build as much green energy, such as wind and solar power, as fast as we can. (**0083-4** [Broadhead, Susan])

Comment: Either turn away from nuclear and toward conservation, efficiency and safe renewable energy production (wind, solar) or turn our planet into an increasingly radioactive, cancer generating, lung disease producing, toxic world. (**0095-6** [Craig, Anne])

Comment: The irony of this proposed toxic nuclear plant is that increased efficiency and downscaling of power usage could render it unnecessary at present. For future needs, I believe that we should develop and build as much green energy, such as wind and solar power, as fast as we can. Two footnotes here: 1) I believe that the fact that nuclear facilities are too risky to be insured by private insurers means that the U.S. government takes the risk, in other words, the public takes the risk-this in addition to having to pay for its installation in the first place. 2.) According to Alan Nogee, former director of Clean Energy Programs for the Union of Concerned Scientists (in which capacity he served for 12 years), now heading up his own Clean Energy Consulting Firm, in 1973 nuclear energy installations cost c. $1/watt and solar PV modules cost c. $100/watt; today, solar PV costs c. $1/watt to install and nuclear costs about $6-$10/watt. So in terms of economics, solar is now more cost effective. (**0098-4** [Broadhead, Susan])

Comment: ...the NRC should be helping this country move away from nuclear power to safe alternatives that do not carry the risk of killing millions of our citizens. (**0111-5** [Knudten, Cori])

Comment: I realize we need to generate more power but with the safety of nuclear power clearly demonstrated in Japan as dangerous, those funds should be used for solar and wind power. (**0123-3** [Thomas Orengo, Cheryl])

Response: *These comments indicate a concern that nuclear power presents a greater hazard than the alternatives. The NRC regulates the nuclear industry to protect the public health and safety. As part of the COL process and in conjunction with the EIS, the NRC staff conducts a safety review detailing a site- and design-specific safety analysis. Therefore, safety issues are generally not discussed in the EIS. As part of the NEPA analysis, the review team evaluated alternative energy sources, including wind, solar, and biomass, in Chapter 9 of the EIS, and compared the environmental impacts from feasible alternative energy sources in Section 9.2.5. The comments did not provide any information that changed the results of that analysis, therefore no changes were made to the EIS.*

Comment: We have here at this time in 2012 a decision point societally where many things are changing, things that are unsustainable are failing, options are being created to perhaps allow courageous people in societies to make other choices than we have made in the past. In the past we have made choices on the energy issue that have resulted in centralized energy production, such as this proposed pair of plants, that has a low probability of utterly massive destruction. The alternate approach which is seen more realistically in the ideas around energy efficiency and solar and wind and other renewables. These are energy options which have a high probability of almost no impact, plus a lot of employment opportunities, and they are sustainable. (**0012-8-3** [Crissey, Brian])

Comment: We remind commissioners that for as much as the plant will cost by the time it is complete the number of gallons of water that will be required to make it work there are better alternatives. These alternatives are solar, wind, geothermal, and other clean and renewable energy sources: low scale, community based, community owned, and safe. Here's some information from the World Bank's website. I'll just quote it verbatim: The World Bank and International Finance Corporation constitute a major financer of solar, photovoltaic, and is developing countries with projects valued at more than 600 million U.S. dollars serving about 1.3 million households and public utilities in about 30 countries in Africa, Asia, and Latin America. Imagine how many households would benefit from a $14 billion investment which it costs for the William States Lee plant. (**0013-13-2** [Bliss, Rachel])

Comment: And I just want to point out again -- which it has been pointed out before -- this -- on one of the slides it says none of the feasible alternatives would be environmentally preferable. That is a lie, that is deceitful, that is not true, and that needs to be -- we need to -- somebody needs to investigate this because this is wrong. You know, to try and to do what you're doing -- to be trying to take -- put one over on the American people -- it's just unconscionable. I can't believe you're doing this. And so I'm just here agreeing with everything everybody said and pointing out that you all are lying. You all are lying to all of us and really do need to change strategies and support renewable and things that are good for the environment and conservation and all that kind of thing. (**0013-28-1** [Richards, Kitty Katherine])

Comment: I believe one answer for retrofitting plants is to put windmills in, pump water uphill, use hydro power. Windmills are very reliable if you use them to pump water. Think about that. Then let's -- I'm going to vote for a prospective senator who has lived off the grid most of his adult life. And I'd like to see all the nuclear submarines docked and their power put into the grid. I'd like to see Americans working at home. Let us build offshore wind power plants and solar collecting plants -- retrofits with products and labor from the Carolinas. (**0013-31-2** [Bisesi, Philip])

Comment: We've got big brains. We can use these to produce other means of energy -- to find other means of energy that will be safe. Wind turbines, solar energy, hydro electric -- which at this point is a bit of a problem as well. We can find these other means of energy production and have a safe and comfortable and a continually advancing society. And as a whole I'm asking all of you to continue thinking about ways to conserve and other ways of finding power. It can be done. (**0013-9-2** [Tinnaro, Heather])

Comment: Let's put our money and jobs into solar and wind energy which are both much more safe and environmental. (**0033-3** [Gardner, Janet])

Comment: According to Alan Nogee, former director of Clean Energy Programs for the Union of Concerned Scientists (in which capacity he served for 12 years), now heading up his own Clean Energy Consulting Firm, in 1973 nuclear energy installations cost c. $l/watt and solar PV modules cost c. $100/watt; today, solar PV modules cost c. $l/watt to install and nuclear costs about $6-$10/watt. (**0083-6** [Broadhead, Susan])

Comment: For the same price, we could build instead a solar array that would provide more local jobs, and provide a safer alternative. (**0084-5** [Lemoing, Melissa])

Comment: ...there are better alternatives. These alternatives are solar, wind, geothermal and other clean and renewable energy sources.... low scale, community-based, community-owned and safe. From the World Bank website comes this article about investments in renewable energy sources. "The World Bank and the International Finance Corporation constitute a major financier of solar photovoltaics (PV) in developing countries with projects valued at more than US$600 million, serving about 1.3 million households and public facilities in about 30 countries in Africa, Asia, and Latin America." Imagine how many households would benefit from an $11 billion investment, the amount estimated to be spent on the construction of the William States Lee plant. (**0104-3** [Bliss, Rachel])

Comment: Wind, solar, tidal & geothermal are much more cost effective than nuclear can ever be. (**0108-1** [Fisk, Bill])

Comment: Finally, building W.S. Lee nuclear power plant is unnecessary because the cost of wind energy is now below the cost of nuclear energy. Renewable energy options don't pose a radiation hazard to the public and the environment. (**0112-11** [Andrews, Josephine] [Anonymous] [Beattie, Kathryn E.] [Boever, Virginia] [Boyle, Ella] [Brogan Prindle, Cathleen] [Davis, John] [Flores, S.] [Hamahan, Clare] [Keil, A. Eugene] [Leverette, Will] [Peterson, Harry] [Peterson, Martha J.] [Rittenberg, David] [Rustin, K.])

Comment: But energy efficiency and renewable energy create more sustainable jobs per dollar of investment than does nuclear. We are told that the proposed reactors are needed for future growth, but the same investment in energy efficiency and renewables will have a greater impact on the energy supply and demand balance. (**0117-8** [Crissey, Brian])

Comment: [The following problems are among those we have identified:] The financial drain to taxpayers and rate-payers of subsidies to the nuclear industry for 50-plus years has interfered and continues to interfere with funding for solar, wind, tidal, geothermal and other suppliers of clean energy, and for conservation measures such as retrofitting, all of which would provide many more jobs for much longer than nuclear.
(**0119-13** [Thomas, Ruth])

Comment: The millions of dollars scheduled for this program would be better spent developing solar and wind applications. Look into the way wind tubes are placed on ridges in France, right on the power line towers, feeding directly into the grid, with no additional damage to the environment or scenic beauty.
(**0120-3** [Wilson, Dawn])

Comment: At a time when we need to incentivize distributed generation of renewables we should not be investing
fortunes in new centralized generation such as this facility. (**0125-2** [Clere, Daniel])

Comment: ...we are letting the rest of the world surpass us - Germany and China, for instance - by using the technologies of the future: solar and wind. I've been to Germany and seen the countless clever ways they use the solar and wind technology, such as: home heating, meter maids, recycling, garage door openers, transit systems, etc. And it's safe. The Germans are no longer building nuclear plants, where as we here in the (esp. southern) United States have so much potential solar and wind power.
(**0143-3** [McAfee, Patricia B.])

Response: *To be considered in detail as reasonable alternatives, the energy alternatives must be technically viable, feasible, and competitive. Alternative actions such as the no-action alternative, energy efficiency and demand-side management (DSM), new generation alternatives, purchased electrical power, alternative technologies (including renewable energy sources such as wind and solar), and the combination of alternatives were considered in Chapter 9 of the EIS. The review team concluded in Section 9.2.3 of the EIS that energy* *alternatives other than coal and natural gas would not be reasonable alternatives to two new nuclear units that would provide baseload power. The review team concluded in Section 10.5 of the EIS that none of the alternative energy options capable of meeting the purpose and need of the project were environmentally preferable to the proposed action. In accordance with NRC guidance, cost is not considered by the staff unless a feasible alternative is found to be environmentally preferable to the proposed action. Ultimately, decisions regarding which generation sources and alternatives to deploy are made by the applicant and regulatory bodies such as State energy planning agencies. No changes were made to the EIS as a result of these comments.*

Comment: And the renewable energy industry actually creates more jobs for every dollar of investment than any other industry, not just energy industry -- than any other industry period. And those are jobs that can local -- locally owned as opposed to corporate owned. (**0013-23-3** [Buscarino, John])

Comment: I agree also with the need for power, although I think that we have yet to really reach for the low-hanging fruit of energy efficiency. So I say let's go for that first. But if you want power, once again, renewable energy. It's what creates jobs and it's what creates our future. So let's look there. And also I just want to address the statement that -- in the Draft Environmental Impact Statement that none of the feasible energy -- alternative energy sources would be environmentally preferable. (**0013-23-5** [Buscarino, John])

Comment: And the other fact is that the Vermont Department of Public Service has a study that shows people who have been talking about sustainable energy. And per megawatt hour that study shows that wood, wind -- and for some reason they only have wood and wind in that study -- employee five people for every one person in a nuclear power plant. So if we put the money into alternative energies you get more people working as a couple of people have pointed out this evening. The use of renewable energies means more local jobs. (**0013-29-2** [Greenburg, Lori])

Comment: Two-is in regard to jobs -when we hear about new plants coming down the pike we almost always hear about the promise of employment. In my former community there were only 257 local employees, most of the plant work was contracted and seasonal by people from out of the area. In fact, The Vermont Department of Public Service has a study that shows an increase in jobs per megawatt hour when people work providing wood, or wind power as compared to nuclear power. Wood and wind employs 5,-people per megawatt hour compared to 1 person per megawatt hour with nuclear energy. Efficiency Vermont employs 3 people/megawatt hour. If you add solar, the increase is even higher. The use of renewable energies means more local jobs. (**0099-2** [Greenberg, Lori])

Comment: Perhaps jobs would be created temporarily in building the two plants in Gaffney. Could we not support even more jobs by subsidizing green industries such as solar energy, wind and water? (**0132-4** [Cahill, Joanne])

Response: *Alternative actions such as the no-action alternative, energy efficiency and DSM, new generation alternatives, purchased electrical power, alternative technologies (including renewable energy sources such as wind and solar), and the combination of alternatives were considered in Chapter 9 of the EIS. Job creation (in the context of socioeconomics) was discussed for those alternatives capable of meeting the purpose and need of the proposed action to provide baseload power. The review team concluded in Section 10.5 of the EIS that none of the alternative energy options capable of meeting the purpose and need of the project were environmentally preferable to the proposed action. In accordance with NRC guidance, cost is not considered by the staff (and no cost-benefit balancing is performed) unless a feasible alternative is found to be environmentally preferable to the proposed action. Ultimately, decisions regarding which generation sources and alternatives to deploy are made by the applicant and regulatory bodies such as State energy planning agencies. No changes were made to the EIS in response to these comments.*

Comment: Other alternatives for generating electric power are available at much lower health risks. Several more acceptable alternatives for electric power include natural gas combustion, photovoltaic cells, wind turbines, and energy conservation. Abundant reserves of natural gas are now available in the U.S. Natural gas combustion causes little air pollution, minor health risks, and requires much lower capital investment than nuclear power plants. Instead of waisting money on building dangerous nulcear power plants, more funds should be applied to research, development, & construction of lower risk power generators using solar energy by photovoltaic cells & wind turbines. Also, more efforts should be applied to educate the public to stop wasting energy by adding extra insulation to homes & commercial buildings, and converting to more efficient lighting, etc. (**0038-1** [Burt, Rick])

Response: *The NRC staff's evaluation of alternative energy sources, including renewable sources such as wind and solar, is in Section 9.2 of the EIS. The staff concluded in Section 9.2.3 of the EIS that energy alternatives other than coal and natural gas would not be reasonable alternatives to two new nuclear units that would provide baseload power. The staff concluded in Section 9.2.1 of the EIS that conservation and DSM would not be a reasonable alternative to providing new baseload power generating capacity. In Section 9.2.2 the staff concluded that natural gas was a feasible alternative to the proposed action. However, in Section 9.2.5 the staff concluded that natural gas was not environmentally preferable to the proposed action. The staff concluded in Section 10.5 of the EIS that none of the feasible alternative energy options were environmentally preferable to the proposed action. The cost of energy alternatives was not considered in the EIS because the options were either not feasible, or were not environmentally preferable. No change was made to the EIS as a result of this comment.*

Comment: The southeast is blessed with an abundance of sunny days and could more easily than much of the nation use this resource to develop solar energy. We can limit the amount of energy needed by sensible energy use, retrofitting older, energy-inefficient buildings and homes, along with many other energy-saving tactics. We do not need these expensive and dangerous facilities. (**0012-10-4** [Connolly, Mary Ellen])

Comment: We can do better and we will do better. I would implore citizens of this community, Cherokee County, to give these numbers a really good look. It's suggested that $14 billion put into a solar -- into solar panel -- into solar power would yield comparable energy and far more jobs: smart jobs, not dirty jobs. Dirty jobs are not what are going to bring real economic development that South Carolina needs. I believe it was 47 is the current number where South Carolina rates in economic development. The future is in solar, folks. The future is in smart jobs, not dirty jobs. And why the added risk when it's just not needed? (**0013-25-1** [Sadler, Timothy])

Comment: Can you imagine what kind of solar installation could be put together for 10 to 20 billion dollars? Also, such an installation could start producing power within weeks, not years! (**0116-6** [Schmitt, Daniel])

Comment: Multiple 5 ? 10 megawatt solar plants would produce equivalent power with less environmental concern, employee more people, be less hazardous and present less of a [terrorism] target and provide redundant mission critical capability. (**0124-6** [Hayes, MD, J. David])

Response: *The review team evaluated the feasibility of solar energy acting as a discrete substitute for the proposed nuclear reactor in Section 9.2.3.3. Although solar power offers some positive environmental attributes, the current state of both photovoltaic and concentrated solar power technology with respect to power conversion efficiency, and the intermittent nature of the power that can be produced erode solar power's attractiveness as a discrete alternative for a baseload power source. A baseload power source must deliver power efficiently, continuously within the control of the facility operator, and not subject to the vagaries of weather conditions. The review team therefore concluded that solar power was not a feasible alternative to the proposed action. Solar power was, however, included as a portion of the combination of energy alternatives in Section 9.2.4. The comment did not provide any information that would change the review team's conclusions. Therefore, no changes to the EIS were made as a result of these comments.*

Comment: I have a proposal for Duke Energy from the people of North and South Carolina. Reinvest your money in sustainable infrastructure. Rather than spending $14 billion on this dangerous 2.2 gigawatt nuclear project you should spend that same money on a 3.9 gigawatt solar project. Here's why. Solar allows for quick incremental deployment. The first solar power rays can start producing within a month of breaking ground, rapidly increasing output as each tiny piece is switched on. It will take almost ten years before this nuclear plant produces a single watt. A $14 billion solar ray could be fully operational before the safety review papers for this proposed nuclear plant even get approved. This multi-billion dollar nuclear plant will create only 3,000 construction jobs, while a solar plant will create 27,000 local jobs during the construction phase. This is fully nine times the jobs created by these proposed nuclear reactors. And, best of all, solar technology takes advantage of the cleanest, safest, and most plentiful nuclear power known to man -- our sun. Duke Energy wants to raise the cost of electricity. They have already raised the price and they are going to raise it again. What better way to use that money than to transition our region into a new era of clean energy infrastructure by building the biggest solar ray in the country. Let's place these two $14 billion projects side by side, one solar and one nuclear. If work on the solar began today it would produce over 50 billion kilowatt hours before the nuclear reactor makes a single watt. And that assumes it comes online in 2016. With the present time line of design, approval, and construction for the William States Lee III Nuclear facility it would take 15 years for these two nuclear reactors to catch up to the accumulated kilowatt hour output of a 3.9 gigawatt solar power plant. My plan provides a quicker return on investment for Duke Energy and clean renewable energy right now for this fast-growing region. In 50 years what does Gaffney's section of the Broad River look like? Let's say these proposed power plants have outlived their usefulness and are ready to be shut down. Even after decommissioning, nuclear reactors leave a mar on the land, a dead zone that cannot be easily cleaned or reused for anything besides another nuclear reactor. Solar panels, in contrast, are nontoxic and fully recyclable, leaving behind nothing more dangerous than concrete footers. The solid-state technology used in today's photovoltaic equipment does not depend on moving parts like pumps, valves, and motors. It does not need backup generators or millions of gallons of water to prevent it from catastrophically melting down. The electronic solar inverters of today are self-regulating, producing only as much energy as needed in any given moment. They also are able to shut down in milliseconds, compared with the several days it take to cool off hot uranium fuel rods. As a specialist in appropriate technologies, I have worked in the renewable energies industry in this state for the past several years, and I know that solar is reliable and effective for any size project. I have personally been involved in hundreds of solar projects across the region helping bring almost 2 megawatts of clean energy online. While the rest of the economy has foundered, the solar industry in this region has grown by leaps and bounds. Finally, with solar panel prices at an all time low it's clear that clean energy in the 21st century is no longer a bourgeois novelty. It has become a cost competitive industry standard. Solar energy is the right choice for the economy of today and for the children of tomorrow. (**0013-10-1** [Gamble, Dan])

Comment: I emphatically propose that there is an environmentally preferable alternative to the William States Lee III nuclear station. This alternative could replace any nuclear power plant, however it is particularly compatible with being installed at this very same site along the Broad River in Gaffney, SC. This alternative is popular with the electorate, and far less controversial than nuclear, coal, or even natural gas. This alternative harnesses the same, virtually unlimited energy source that has reliably powered our planet for billions of years. Every human being recognizes its potency and can attest to its reliability. I propose that we harness the power of the sun, using industry tested and proven methods that have become newly affordable in 2011 with the massive increase in the global production capacity of both crystalline silica and pre-assembled Photovoltaic Modules. Solar

Alternative for New Baseload Development:

Categorical Justifications

Waste: Solar PV generates no nuclear waste, and minimal landfill material. It has no ongoing mining or transportation of fuel, and no need to process effluent. As such, it is incomparably superior to any conventional means of electrical power production.

Availability of modules: Solar Photovoltaics are a mature technology, with global acceptance and a growing list of manufacturers, together producing around 30 Gigawatts of modules annually. The photovoltaic effect has been a recognized means of producing electricity since the 19th century, and has been successfully used for power production throughout the past 50 years in such extreme conditions as the Sahara desert, Antarctica and the vacuum of space.

Finally, in 2011, solar PV has surpassed the initial investment costs of building new nuclear reactors (per MW nameplate rating). Thus, solar power will likely dominate the 21st century as the only cost-effective power source limited neither by fuel prices and availability (like all conventional power sources) nor by specialized geographical phenomena (like wind, hydro and tidal energy). Cost Solar PV is cost competitive. The Lee Nuclear Station will produce 2.2 Gigawatts for a cost of 14 billion dollars (6.36 dollars per watt). This is expensive when compared with solar power, at an installed market price of $3.00 per watt (as of mid-2011), 14 billion dollars = 4.67 Gigawatts. Given the statistical hourly availability factor of 25%, or even the more conservative 20% availability in this area adjusted for statistical weather events and a 5 degree low profile array tilt, this is the equivalent of a 1 Gigawatt plant running 24/7.

Furthermore, given the falling cost of solar and rising cost of nuclear, we can project the cost of a solar facility that would come online by 2023, the completion date proposed for the second reactor at the Lee Nuclear station. Due to the relatively quick deployment time of solar (China put 2 gigawatts online in 2011 alone), and the 15% annual decrease in price, we can project that a 10 Gigawatt solar plant (equivalent annual kWh output to a 2.2 Gigawatt Nuclear facility) would take 5 years to complete and cost around 11 Billion dollars if begun in 2018. Other factors further improve the case for solar, as these up-front costs do not account for either cost of upkeep (Fuel costs, maintenance, personnel, etc) or return on investment (Deployment time, interest payments, disaster insurance, waste storage). For a nuclear facility, these expenses equal hundreds of millions annually, while for solar these costs are near zero. (**0129-1** [Gamble, Dan])

Comment: Solar Photovoltaics do not evaporate any water during normal operation, and could even be used to harvest rainwater for agricultural or municipal distribution, using integrated gutter systems. The 2000 acre Lee site alone could collect 54 million gallons of water for each inch of rainfall, or approximately 2.5 billion gallons per year, enough to fill "pond A" 6 times annually. (**0129-4** [Gamble, Dan])

Comment: Storage
Water is more than just the fundamental unit of all life on earth. It can also the answer the question of storing solar energy, so that it will be available 24/7. Duke Energy Carolina currently operates 1.8 Gigawatts of pumped storage hydroelectric facilities less than 100 miles away. Currently, these pumping stations are being used to store waste energy from existing base-load plants, which have significant excess capacity. If there is truly need for building additional base-load generation for 2023, as the proposed nuclear station pre-supposes, then these pumping stations will be obsolete in their current occupation, as there will be no significant waste energy to be stored. Thus, these pumping stations must be repurposed as storage facilities for renewable energy, creating a battery that can be charged during daylight hours to make solar energy available even at night. Repurposing these existing facilities is certainly the most cost-effective storage solution, as they are already connected to the 525-kV Oconee-Newport line intended for use by the proposed Lee site.

If on-site storage is a necessity, two notable battery technologies exist that are currently operating in utility-scale projects: Sodium Sulfur and Zinc-Bromine. Sodium Sulfur batteries, the most affordable non-toxic technology to date, at this scale would add approximately 300 million dollars per GWh of storage capacity to the project cost. These are commercially available from NGK corporation of Japan, and are being used in systems from 3 MWh to 2 GWh in Japan, France and the U.A.E.

In order to satisfy the future need for base load development, it is clear that one of the above, industry proven technologies will need to be included in this project. In combination with solar PV, either pumped water storage or sodium sulfur batteries will satisfy South Carolina's definition of "base load" as a facility "greater than 350MW and having at least 70% availability". (**0129-5** [Gamble, Dan])

Comment: Let us address the one remaining impediment to massive deployment of solar energy: the question of acreage. The environmental impact of installing solar PV on thousands of acres of land would be tremendous if it were to replace forests, wetlands or agricultural fields. Using virgin land for solar farms on this scale would be absurd. Fortunately for solar, our society has already turned millions of acres into barren wastelands ripe for the planting with solar panels. In the United States public road systems alone, there are over 12 million acres of pavement (assuming 12 ft wide lanes, not including medians). Privately owned rooftops and parking lots account for millions more. Based upon the SRCC's national average minimum solar irradiation of 1000 BTU/sq ft/day, 12 million acres of road adsorbs 540 trillion BTUh per day (less 3-5% reflectance), contributing significantly to climate change vs. more highly reflective natural landscapes. If less than half of these roads were to be covered with PV, it would provide 100% of our nation's annual kWh needs. While there are many strategies for distributed generation using solar PV, I advocate using public roads for these reasons:

- Harvest rainwater and eliminate stormwater runoff
- Use existing easements
- Simplify maintenance access
- Extend life of roads (UV and freeze-thaw protection)
- Increase safety of driving (eliminate water on roads)
- Built in electrical distribution network that is proportional to population density and adjacent to points of use
- Make new jobs where they are needed most - in places of high population density
- Employ existing maintenance crews and equipment

Other popular land management strategies include pastureland amongst pole-mounted PV arrays, rooftop solar arrays and solar parking structures. If Solar is installed on the proposed Lee Site, the 2000 acre site can accommodate 1 Gigawatt capacity of the most affordable commercially available solar modules, given a 5 degree south-facing tilt. (30%-40% higher energy densities are available from SunPower Corp. for a significant cost increase). A 5 degree tilt will increase summer production, while decreasing winter production, for a total annual kWh loss of 8.5% vs. the "ideal" latitude tilt of 35 degrees. However, this small sacrifice is more than justified considering the increased energy density and reduced land disturbance. In recent years, low tilt systems have become the industry standard for large-scale rooftop installations. (**0129-6** [Gamble, Dan])

Response: *These comments present a proposal for the use of solar power as an alternative to the proposed nuclear units, and attempt to address both the positive attributes of solar and its drawbacks. The review team evaluated the feasibility of solar energy acting as a discrete substitute for the proposed nuclear reactor in Section 9.2.3.3. Although solar power offers some positive environmental attributes, the current state of both photovoltaic and concentrated solar power technology with respect to power conversion efficiency, and the intermittent nature of the power that can be produced erode solar power's attractiveness as a discrete alternative for a baseload power source. The commenter attempted to address the intermittent nature of solar power by postulating that existing pumped-storage facilities could be used to smooth the output of the solar facilities. However, the pumped-storage facilities are already in use and the review team expects they would continue to be used in conjunction with the existing power generation facilities. There is no basis to assume the pumped-storage facilities could be repurposed as the commenter indicates. Therefore, the primary issue with solar—its intermittent nature—remains as an obstacle to meeting the need for baseload power. A baseload power source must deliver* *power efficiently and continuously within the control of the facility operator and not be subject to the vagaries of weather conditions. These same issues are discussed in Section 9.2.3.3, in which the review team concluded that solar power was not a feasible alternative to the proposed action. The comments did not provide any information that would change the review team's conclusions. Therefore, no changes to the EIS were made as a result of these comments.*

Comment: This pellet is a simulated fuel pellet. In our current early technology of nuclear energy, it releases as much heat energy as burning a ton of coal. A ton of coal would fill up a pickup truck, a big pickup truck. Instead, we have these little pellets that we put in the fuel rods. Nuclear power plants operate for 18 months on three truckloads of commercial nuclear fuel. Instead, if a same size power plant was burning coal, it would require 100 train carloads of coal every single day. That's about 10,000 tons of coal and it releases 40,000 tons of CO_2 into the atmosphere, as opposed to a nuclear plant which releases no CO_2 into the atmosphere. Yes, there's a little CO_2 involved with mining, but when you're mining real concentrated material, you don't use much to move it around the world. (**0012-12-2** [Adams, Rod])

Comment: Compare that to the alternative, in the U.S. today, yes, I'd say we can reduce some use of electricity, maybe, but we burn a billion tons of coal and 6 trillion cubic feet of natural gas to produce electricity. Why, if you're going to conserve, would you shut down the cleanest source of electricity [nuclear] instead of those dirty sources first? (**0012-12-5** [Adams, Rod])

Comment: Right now there's people in the U.S. that say we have a huge supply of natural gas that's going to supply us forever. I've done the numbers, all of the natural gas that we have today in the U.S., if we burn it at the rate we burn it today, will last 90 years. We have 2,170 trillion cubic feet, we burn 24 trillion cubic feet a year, do the math, 90 years. (**0012-12-6** [Adams, Rod])

Comment: I wish we were here today talking about an alternative energy source that could solve our problems. Solar, biomass, wind, they all are good options. Duke, in fact, has continued to lead the effort in finding alternative energy sources. I also wish we could live a more sustainable lifestyle and have capacity issues solved by diligence and energy conservation, but the fact is that won't happen. We have three major choices: coal-fired units, hydroelectric, and nuclear to satisfy those increasing demands. Of those three, I choose nuclear. I've been around long enough to remember the proposed concept to dam the Broad River. It was met with outrage by the local citizens. In 1988 I was at a hearing much like this and thank goodness we had York County Sheriff's deputies there. The outrage associated with another hydroelectric project paled in comparison to the discussion we've had here today. I've also seen resistance to other coal-fired units. In fact, worried myself about fly ash, burned hydrocarbons and acid rain. And I've also seen nuclear operations provide thousands of megawatts of reliable power in North and South Carolina with very limited environmental impact. As I tell my children, life is about choices. There's no form of power generation with zero impacts on our environment, not even wind and solar. (**0012-16-2** [Farris, Mark])

Comment: Business and residents are extremely supportive of expanding nuclear capacity in the state. There are no other alternatives currently available or as reliable as nuclear in providing baseload power in a carbon-free manner. (**0012-5-3** [Rawl, Otis])

Comment: That power is the same kind of power that we are going to be using here at the William States Lee Nuclear facility. That facility will be 2,200 megawatts. If it was being powered by coal it would require a 200-car trainload of coal every single day. Instead, it's going to need about six, eight semi- tractor trailer loads of fuel every 18 months. The environmental impact of that plant will be significantly lower than any other alternative. We had a solar salesman up here talking about how solar power is so great. What is the solar power of his 3,200 megawatt facility between the hours of 6:00 p.m. and 6:00 a.m.? Zero -- absolutely zero. During -- I'm sorry. I'm a retired sailor. Okay. I spent 33 years in the Navy so my language sometimes goes off. But the reality is the sun does not stay up all the time, believe it or not. Also, the wind doesn't blow all the time. People call renewables renewable. What I call them is unreliable. We need power when we need power. There's no way to store it. We've been studying that stuff for 100 years. Thomas Edison invented batteries over 100 years ago and we still haven't got anything better because chemistry is chemistry -- it doesn't change. Physics is physics. We know how to produce electricity reliably, safely. (**0013-12-2** [Adams, Rod])

Comment: And if we decide we're going to use natural gas to replace coal, to replace nuclear, and to power semi-tractor trailers across the country like T. Boone Pickens wants to do we'll run out of natural gas a lot quicker than that. We don't have the ability to produce wind power reliably because the wind doesn't blow. (**0013-12-4** [Adams, Rod])

Comment: We've been studying energy for a long time. We've known the sun has energy for thousands of years. We've known the wind has energy for thousands of years. We've only know about nuclear for the last 62 years, and we've done pretty well at making it a reliable power source in competition with the coal and oil and gas, in competition with those. It replaces them, it pushes them out of the marketplace, which is one of the reasons why Wall Street doesn't like nuclear, because Wall Street likes coal, oil, and gas (**0013-12-6** [Adams, Rod])

Comment: We've heard a lot about Germany lately. I found some numbers today. Germany's trying to shut down their plants by 2022. The German Association of Industrial and Commercial Energy Cost Customers estimates the cost of an early nuclear exit to be over $4.5 billion per year, which, of course, gets transferred to the people paying the bills. Also, there's -- nuclear is a clean 24/7 baseload source of power, provides almost 20 percent of U.S.'s energy. Unlike wind and solar, nuclear can provide electricity around the clock, even at night when the wind isn't blowing. We heard earlier -- I just want to mention -- a 3.2 gigawatt solar plant that he thought he could build. He also mentioned that he's built -- worked on over a hundred solar plants in the Carolinas. The numbers added up to two megawatts for all 100 of those. So 3.2 gigawatts for one solar farm seems a little bit unreachable. According to the Department of Energy's voluntary reporting of greenhouse gases in 1997 report the single most effective emission control strategy for utilities was to create nuclear generation. In 2010 nuclear energy accounted for 69% percent of the U.S.'s emission-free generation. (**0013-17-4** [Reichenbach, Adam])

Comment: Alternatives to that are coal, solar, wind, hydro, natural gas. Without trying to go into the discriminators between all of them -- the problem, and as mentioned here before, solar and wind are not reliable. They're periodic suppliers. The energy might be free; the capital cost is not free. The cost per unit of energy delivered is higher than a nuclear plant. Coal is very dirty. I don't know -- there's probably nobody in this room that would like to see a coal plant built near them. I used to work at a coal plant when I was in college. They are quite dirty. Hydro's really not an option for here. Natural gas is probably the closest alternative to nuclear power. However, it's a limited resource. It still is a fossil fuel that emits pollution into the atmosphere that nuclear power plants don't. In summary, nuclear plants are clean, safe, economical, but, most importantly, they're reliable. Electricity -- lots of electricity 24 hours a day, seven days a week. (**0013-18-3** [Bromm, Bob])

Comment: Nuclear power is the cleanest and most efficient source of power that we have. I live near Asheville, NC and I welcome having a nuclear power plant close by, although, I would not welcome a coal burning plant. (**0054-2** [Gaddy, Ron])

Comment: I personally think that the environmental risks are very small compared to a coal plant. With government oversight, nuclear plants are very safe. (**0054-4** [Gaddy, Ron])

Response: *The comments express views that nuclear power is a good alternative compared to other energy generation options. The comments are generally supportive of the finding of the review team in Section 9.2 of the EIS that a number of the alternatives are not capable of meeting the project purpose and need, and that none of the feasible alternatives is environmentally preferable to the proposed action of building two nuclear units at the Lee Nuclear Station site. No changes were made to the EIS as a result of these comments.*

Comment: I think we have to look at a better alternative. I'm happy to say that the United States Department of Energy, on January 12, 2012, seven days ago, released two groundbreaking information resources on national hydrowave and tidal energy resources. According to those reports, which are called the most comprehensive of their kind to date, these water power resources, if developed, could supply one-third of the total U.S. energy demand by 2030. That's not so far away. It would take four or five years before this place could come online if it was built, and I hope it's not. But hydrowave and tidal are among the best of the 20 sources in the EROEI analysis that I cite, and they are all greatly superior to nuclear, both in terms of what you get out for what you put in and in carbon footprint, and hydrowave and tidal are free. These are all greatly superior to nuclear, they're being used in other countries as well as some here. Holland uses tidal and wave generation of electricity and has for some years. The technology is there, it's safe, it works. And another thing nice about it is all of these waterborne, tidal and ocean doesn't take anything out of our rivers and doesn't put anything in them. All of these can support baseload demand, and that is one of the reasons we've seen things like solar, and rightly so, solar is weak on baseload demands and wind power is sporadic, but tides, waves are pretty darn stable and pretty long lasting. So pursuing this, thanks to the U.S. Department of Energy's recent work, this shows us a better path, and I would hope that we would pay attention and put our money, resources, energy and efforts in that manner. (**0012-13-5** [Howarth, Robert F.])

Comment: Other alternative means of power generation can be brought on line in less time, provide many more construction jobs for many more companies, are less risky, do not require large taxpayer liability subsidy, and do not hold the threat to my health, your health, and ecological health posed by operation of nuclear plants and centuries of storing toxic radioactive wastes. A Better Alternative The U.S. Department of Energy on Jan. 12, 2012 5released two groundbreaking information resources on national hydro, wave and tidal energy resources. According to the reports -the most comprehensive of their kind to date - these water power resources, if developed, could supply 1/3 of total U.S. electricity demand by 2030. Hydro, wave and tidal are among the best of the 20 sources in the EROEI analysis I cite, all are greatly superior to nuclear, and all can support base load demand. (**0093-6** [Howarth, Robert F.])

Response: *The NRC staff recognizes that when evaluating energy alternatives to the proposed project, particularly for technologies that are being developed, the evaluation must include relevant information representative of the current technology. However, the viability of various alternatives to the proposed project is pertinent to the discussion to the extent that the alternative must be capable of reasonably replacing the baseload energy supplied by the proposed project. The alternatives must be technically viable, feasible, and competitive. In accordance with staff guidance (ESRP 9.2.2), the energy-conversion technology should be developed, proven, and available in the relevant region. The staff is not aware of any specific siting, development, or operation of the types of wave and tidal-based hydropower resources described in the comments in this region that are on a large scale (i.e., 10s or 100s of MW). Therefore, this alternative will not be addressed in the EIS. No changes were made to the EIS as a result of these comments.*

Comment: We [Clean Water for North Carolina] support the energy conservation alternative in Section 9.2.1.3 of the draft EIS. Despite the NRC's claim that this method isn't a reasonable alternative, our extensive research has shown that demand reduction through energy efficiency programs is the most cost- effective and job-creating strategy for meeting our energy needs. (**0012-7-8** [Hicks, Katie])

Comment: ...the most cost-effective way to approach the energy supply and demand and environmental issues around energy is energy efficiency. It produces more jobs, it's safer, it has a bigger impact per unit of dollar and energy than any of the other approaches. (**0012-8-1** [Crissey, Brian])

Comment: ...since people are talking about wasting energy I just thought I would give you some real statistics that my husband I have collected. In 2005 I finally convinced the family to turn off things that weren't being used. So in one year just by turning off what we weren't using we reduced our kilowatt hour usage by 43 percent. So I don't think we're really that unusual or atypical. So I just think that this could be a possibility. (**0013-22-1** [Larson, Jean])

Comment: But I want to talk more about the alternatives. And one of the alternatives that is really the most overlooked is energy conservation. Did you know that in Europe the energy consumption is about 40 percent less than what we consume in the United States? That's Europe, folks. They have a high standard of living. We're not talking about the Third World here. Although if you want to talk about the Third World there is a very low energy consumption in Peru, where I just was. And the fact is that we can do a lot better with energy conservation. Energy conservation is an amazing contributor of jobs. And those are local jobs, they are good jobs, they are jobs that last for a lifetime as opposed to some of these nuclear power plant construction jobs that are just short term. We're talking about jobs that could be considered green collar jobs, like weatherizing homes, stopping the energy leaks. Emory Levins used to say instead of -- if you have a stopper to plug up your bathtub, then you don't have to keep filling it up with hot water every five minutes. So we need to design better energy efficiency, and actually just to utilize the energy efficiency measures that we already know about. This would help to improve the housing stock for many poor people who are, you know, spending tremendous amount of money trying to heat their homes, sometimes with electricity, because that's the only thing that they have. We need to realize all of the amazing wealth of knowledge that's out there about energy conservation. The problem has been, of course, that we have energy industries which really do not want conservation. So they may give lip service to conservation and they may do a little bit so that people are fooled into thinking that, oh, yeah, they've already done the conservation bit. Well, I'm sorry, but we should at least be able to catch up with where Europe is. (**0013-32-2** [Holt, Cathy])

Comment: We as a species need to begin thinking about what we can do differently in our lifestyle. And the comment was made, Well, I leave my computer on during the day, I leave this on, I leave that on. Each one of us has a responsibility to use as little power as possible. And I think what we're losing sight of here is that conservation is a source. That's where we all need to begin. And then after conservation we need to look at renewable, safe energy systems. (**0013-5-3** [Cremer, Claudine])

Comment: [Before acting on this proposal, adequate AND PUBLIC review should include:] Approaches to eliminate or minimize growth in energy consumption should be considered as well. (**0021-4** [Rinsler, MD, Steve])

Comment: I would be more in support of energy conservation efforts and education and less toxic forms of energy production like wind and solar. (**0022-4** [Sloss, Barbara])

Comment: Let's all cut back on our electric usage which not only affects our individual bottom line, but also protects the environment for future generations. (**0035-2** [Gardner, David])

Comment: Conservation alone would eliminate the need for more electricity. (**0085-4** [Allison, Patricia])

Comment: Conservation & efficiency alone can eliminate the need for this plant. (**0086-4** [Rylander, Kimchi])

Comment: The Southeast has done very little to reduce use of electricity. We can make significant reductions with little effort and few dollars spent. In 2005 my family decided to simply turn off lights when we left a room and turn off the TV, radio and music when we were no longer paying attention. We also change most light bulbs to CFLs. In one year we reduced our KWHs used by 43%. We had been needlessly wasting energy. When we decided to stop using the dryer and hang our clothes on a drying rack we reduced our usage from 2005 by 62%. I am guessing that our family is not that different than others and they, too, could save about 30 to 40% of the KWHs used by turning off what they no longer need to have on. (**0097-1** [Larson, Jean])

Response: *The comments suggest that energy efficiency and conservation would be a better alternative than the proposed nuclear units. Any alternative energy source must be able to meet the purpose and need of the action (i.e., production of 2200 MW(e) of baseload power to supply the future needs of the service territory). As discussed in Section 9.2.1 of the EIS, the review team concluded that conservation and DSM programs are very successful in reducing peak load. Duke's programs in these areas are expected to offset the need for 1800 MW(e) of generation by the year 2030. However, those savings have already been accounted for in power planning and there is still a demonstrated need for additional baseload capacity, as discussed in Chapter 8 of this EIS. Thus, the implementation of conservation and DSM programs is not a reasonable alternative for providing baseload power generating capacity. No changes were made to the EIS in response to these comments.*

Comment: Section 9.2.5, Page 9-38, Lines 20-23: Referring to Table 9-5, the DEIS states: "Considering the addition of life cycle greenhouse gas emissions from the production of electricity from a nuclear power source, i.e., those from the fuel cycle and transportation of workers, total emissions for plant operation over a 40-year period would increase to about 54,000,000 MT." Because Table 9.5 represents "Direct Carbon Dioxide Emissions", carbon emissions estimated for the coal-fired, natural-gas-fired, and combination alternatives shown in Table 9-5 presumably also do not include fuel cycle and transportation-related emissions. (**0134-70** [Fallon, Chris])

Response: *The commenter is correct. However, the review team believes that the current text is sufficiently clear. No changes were made to the EIS as a result of this comment.*

Comment: Section 9.2.2, Page 9-7, Lines 19-23: The DEIS states: "the EIA reference case is projecting that between 2010 and 2035, natural-gas-fired capacity would account for approximately 60 percent of new capacity additions; renewable energy sources would account for approximately 25 percent of new capacity additions; coal-fired capacity additions would increase by 11 percent; and new nuclear plants would account for approximately 3 percent of new capacity additions (DOE/EIA 2011)." The coal-fired capacity will not increase by 11 percent; rather coal-fired capacity will account for 11 percent of the new capacity additions. (**0134-69** [Fallon, Chris])

Response: *The commenter is correct. Section 9.2.2 was revised to indicate that coal would represent 11 percent of new capacity additions.*

Comment: I honestly just don't see how that conclusion [environmentally preferable] can be legitimately reached with the life cycle of radioactive waste. This is incalculable generations out into the future that this would effect. So, yeah, I would just like to ask you to invest in my generation's future. (**0013-23-6** [Buscarino, John])

Response: *This comment concerns Section 9.2 of this EIS regarding radioactive wastes as a factor in the energy alternatives assessment. As discussed in the Section 9.2.5, Summary of Comparison of Energy Alternatives, the distinguishing impacts among the energy alternatives are primarily related to emissions from the alternative generation sources (air quality). The footnote for Table 9-4 indicates that the conclusions for the environmental impacts from nuclear energy are presented in Chapters 4 and 5. This excludes the impacts related to the fuel cycle and transportation which are presented in Chapter 6. This apparent exclusion was not intentional. The review team agrees that the impacts related to the fuel cycle and the associated transportation impacts should be included for the nuclear option. The footnote to Table 9-4 has been modified to reflect the inclusion of these impacts. As discussed in Sections 6.1 and 6.2 of this EIS, the environmental impacts related to radioactive waste and transportation are SMALL. The review team concluded that the impact category for Waste under the nuclear option is SMALL with the impacts of the fuel cycle included. The comparison of nuclear to the other energy alternatives is unaffected. The distinguishing resource area impacts between the alternatives (air quality and waste for coal, air quality for natural gas, and the combination of alternatives) remain. The review team concludes that none of the alternatives is environmentally preferable to the proposed nuclear units.*

E.2.22 Comments Concerning System Design Alternatives

Comment: CHAPTER 9 -ENVIRONMENTAL IMPACTS OF ALTERNATIVES
DNR has concluded the Licensee has conducted a thorough and exhaustive review of the need for obtaining additional water supply for safe operation of the proposed facility during periods of extreme drought. A number of the alternatives that have been put forward for additional water supply represent engineering solutions exceeding the capability for DNR analysis. DNR is

satisfied the Licensee has identified the least damaging alternative to natural resources for provision of additional water supply based on comparison of alternative supplemental water supply options. (**0126-29** [Vejdani, Vivianne])

Response: *This comment states that the SCDNR is satisfied that the applicant has identified the supplemental water supply alternative that is least damaging to natural resources. No change was made to the EIS as a result of this comment.*

Comment: [Recommendations:] Water sources that would reduce impacts to Water of the United States should be explored, and these and other alternatives evaluated in the FEIS. The FEIS should explain the rationale for exclusion of alternatives that are eliminated from consideration. (**0142-13** [Mueller, Heinz])

Comment: Alternatives in the DEIS include the no-action alternative, energy source alternatives and system design alternatives. Regarding design alternatives, we note that the NRC recently approved the Westinghouse AP1000 pressurized reactor design in a design certification process. 40 CFR Part 230.10(a) requires that the preferred alternative should be the least environmentally damaging practicable alternative (LEDPA).

EPA reviewed the Joint Public Notice (JPN) and submitted comments regarding the compensatory mitigation and permit action under separate cover on March 6, 2012 (see enclosed letter to USACE). EPA's letter states: "*The applicant has explored many alternative sites and alternatives for cooling water sources. However, the EPA recommends further analysis of possible avoidance and minimization, as well as a more comprehensive alternatives analysis. The applicant states in the Draft Environmental Impact Statement dated December, 2011 (DEIS) that using a Combination Wet/Dry Hybrid Cooling-Tower System would reduce the water required from Pond C from 9,874 acre-feet to 2,804 acre-feet, a 72 percent reduction. While the applicant states this would not fully eliminate the need for Pond C, it could greatly reduce the needed size of the impoundment allowing a smaller footprint at the current location or allowing the impoundment to be relocated. Further, water sources such as offline impoundments that would eliminate impacts to Water of the United States should be explored, and we recommend that these and other alternatives be integrated into the Final Environmental Impact Statement (FEIS)*. "

Recommendations: We appreciate the analysis of many alternative sites and alternatives for cooling water sources. However, EPA recommends further analysis, in order to avoid and minimize environmental impacts related to water sources for the proposed project. The FEIS should document the evaluation and decision processes, and discuss the rationale for exclusion of alternatives that are eliminated from consideration. (**0142-4** [Mueller, Heinz])

Response: *These comments suggest further analysis of alternative water sources for the two proposed units. Duke provided detailed analyses of alternative water sources in its supplement* *to revision 1 of the ER and subsequent responses to requests for additional information. The review team evaluated other potential water sources in the area and determined that there are no viable alternatives to the Broad River. As a result, the review team concluded that none of those water supplies were environmentally preferable to that proposed for use at the Lee Nuclear Station site. The review team's evaluation of alternative water supplies is presented in Section 9.4.2 of this EIS. No changes were made to the EIS as a result of these comments.*

E.2.23 Comments Concerning Alternative Sites

Comment: I am writing to state that as a resident of Buncombe County in North Carolina I do not want to see a nuclear power plant within 60 miles of my home. My understanding is that there may be one located in Gaffney, SC. I sincerely hope you will consider relocating it further away from our area. (**0008-1** [Kelly, Kitty])

Response: *In its search for alternative sites, Duke started with a region of interest defined as its service territory. The use of a defined service territory is consistent with the staff guidance in ESRP 9.3, as discussed in Section 9.3.1 of the EIS. Duke, and the NRC staff in its evaluation in Section 9.3.1, did consider alternative locations throughout Duke's service territory. The NRC staff concluded in Section 9.3.6 that none of the alternative sites were environmentally preferable to the proposed Lee Nuclear Station site. No changes were made to the EIS as a result of this comment.*

Comment: Section 1.4, Page 1-13, Lines 17-19: Duke Energy no longer owns the Middleton Shoals Site. The site was owned by Duke at the time of the siting study but was transferred to Crescent Development when Crescent was separated from Duke Energy.
(**0134-4** [Fallon, Chris])

Comment: Section 9.3.5, Page 9-156, Lines 2-3: The DEIS states: "The Middleton Shoals site is wholly owned by Duke, and is maintained as forested land." The site was owned by Duke during the alternative site evaluation (Environmental Report 9.3.2.1, page 9.3-8 and 9.3-9); however, the land was transferred to Crescent Development when Crescent was separated from Duke Energy. (**0134-78** [Fallon, Chris])

Response: *The comments request changes to the EIS to reflect the fact that the Middleton Shoals site is no longer owned by Duke. (It was owned by Duke at the time of the site-selection study.) Changes were made to Sections 1.4 and 9.3.5 to reflect the change in ownership.*

Comment: Section 9.3.3, Page 9-48, Table 9-6: Shearon Harris Units 2 and 3 should also be identified. (**0134-71** [Fallon, Chris])

Response: *The commenter is correct, proposed Units 2 and 3 at the Shearon Harris site should have been included in the table. The only portion of the review of the Perkins site that* *would be affected is the evaluation of severe accidents in Section 9.3.3.11. In the draft EIS, the staff had already included the two proposed units at Shearon Harris site in its evaluation, even though the units were not listed in the table. So, no changes are required to that section. Table 9-6 was revised to include the two proposed units at the Shearon Harris site.*

Comment: Section 9.5, Pages 9-213 and 9-214: The Section 404 permit application submitted in November 2011 provides updated acreages and linear feet for impacts to wetlands, open waters, and streams. The application also provides updated acreages and linear feet of wetlands, open waters, and streams within the entire project boundary. The permit application includes impacts not only from fill, but impacts resulting from draining and dredging of open waters, inundation, and clearing of forested wetlands. This section should be revised using acreages in the permit application. Additionally, impacts should be described to clarify that not all impacts are directly due to the placement of fill. For example, out of the 67,275 linear feet of impacts to streams, 60,414 linear feet are due to inundation and not fill. It would also be helpful to distinguish between permanent, temporary and clearing impacts. (**0134-84** [Fallon, Chris])

Comment: Section 9.5.2, Page 9-214, Table 9-19: This table should be updated with acreages and linear feet provided in the Section 404 permit application. Either the subheading of "Sites" should be changed to reflect that these impacts also include those from the supplemental cooling water reservoirs or impacts from the cooling water reservoirs should be separated into another subgroup and labeled separately. It may also be helpful to remove the word "fill" from the row headings, since many of these impacts do not directly result from the placement of fill. (**0134-85** [Fallon, Chris])

Response: *The text and table in Section 9.5, U.S. Army Corps of Engineers Alternatives Evaluation, have been edited to reflect updated impacts to wetlands, streams, and open waters contained in the November 2011 Section 404 permit application and the commenter's suggested changes.*

E.2.24 Comments Concerning the Benefit-Cost Balance

Comment: In addition, Duke Power is proposing a rate hike from its customers to fund the purchase of Progress Energy and the construction of this unwanted nuclear power plant! (**0001-4** [Stoll, Irene])

Comment: Duke Power is apparently expecting taxpayer guarantees on this construction??if it were truly a wonderful idea there would be much private money available and taxpayer involvement would not be necessary. (**0002-4** [Smy, Gayle and Allison])

Comment: Rate payers and taxpayers should not have to pay for a plant they do not want and Wall Street won't touch! (**0004-10** [Cunningham, Kristine])

Comment: Nuclear power is too expensive and dangerous, both in start up costs and in long term environmental hazards and waste materials. (**0005-3** [Lewis, Brenda K.])

Comment: The cost of commercial nuclear fuel today is 65 cents per million BTU. Now, a lot of people don't deal in million BTUs, but that's the market that we use for natural gas in the U.S. If you look on Bloomberg, you'll see that cheap natural gas, the stuff that everybody is so excited about, costs $2.75 per million BTUs today. Back in 2008 when the manufacturers in South Carolina were having so much trouble, part of the reason they were having trouble in 2008 was the cost of natural gas had skyrocketed up to about $14 per million BTU. Compare that to 65 cents per million BTU from commercial nuclear fuel, and that price has been relatively stable, even not adjusting for inflation, for about 25 years. There's no projection that that cost will go up because that cost includes the cost of disposal, it includes the cost of enriching the material, it includes the cost of mining, transporting, storing and interest on the investment during that time. (**0012-12-3** [Adams, Rod])

Comment: Affordable, $14 billion and a price tag that is likely to increase. The ones that I've been familiar with over the years, I was deeply involved in trying to stop the Clinton Nuclear Power Plant in Illinois back many years ago, it was said this is going to be efficient, it's going to be $1 billion, turned out to be $4-. I mean, these prices continually go up, this was $11-, now it's $14-, what's it going to be later? Where is the line item that includes the cost of proper, with integrity, waste management? That's off-loaded, that's not shown in the costs. Who pays for that? Well, the taxpayers. Well, that's still us. (**0012-8-4** [Crissey, Brian])

Comment: I've heard talk about cost. From our perspective, cost is a big deal, believe me. We will be paying the lion's share of the cost of these facilities, and my members understand that, and they have had a lot of give and take with Duke Energy over that fact, regarding the nuclear plants in particular. That's not an easy thing for us to look at, but it's something that has been a big issue for us and we understand that this is money that should be invested at this time in these facilities. (**0012-9-3** [Gossett, Lewis])

Comment: Whereas since the 1970s Wall Street has advised against investment in the nuke industry U.S. taxpayers shoulder the entire financial risk through federal loan guarantees to an industry with default rates of well over 50 percent. (**0013-11-7** [Smith, Coleman])

Comment: Historical Money Problems: Price tag for the 2 nuclear reactors has grown from $11 to $14 billion. Duke Power wants customers, 70% in NC and 30% in SC, to pay pre-construction costs through rate hikes in addition to taxpayers shouldering the entire financial risk through Federal Loan Guarantees. Another Bail-Out ? Wall Street won??t invest because as the Congressional Budget Office says, default rate on loans for new reactors ??very high well above 50%. Duke and Progress said their proposed merger was the only way to build more nuclear but the Fed. Govt. has refused the request twice in opposition to such a large monopoly. The estimated start up date is from 2018 to 2020. (**0017-7** [Morgan, Tom and Barbara])

Comment: The complete costs for this reactor would be staggering and shouldered by Duke Power customers and American taxpayers, an aweful burden in these bad economic times. (**0019-5** [Doebber, Tom])

Comment: The complete costs for this reactor would be staggering and shouldered by Duke Power customers and American taxpayers, an aweful burden in these bad economic times. (**0020-5** [Klein, Art and Michelle])

Comment: Nuclear power plants are expensive to construct and maintain. (**0022-2** [Sloss, Barbara])

Comment: Nuclear power is not a cost-effective solution; in fact, it would tie up huge amounts of capital which can be more quickly, equitably and safely used for efficiency/conservation and renewable energy. (**0024-1** [Whitefield, Anne])

Comment: The complete costs for this reactor would be staggering and shouldered by Duke Power customers and American taxpayers, an aweful burden in these bad economic times. (**0026-4** [Doebber, Ian] [Doebber, Rachel])

Comment: On a personal issue, I do not want my own electric bills to soar upwards in order to pay for building a plant that I am extremely opposed to. (**0030-6** [Swing, Carol])

Comment: Who is going to pay for this mega project? As a retired person living on a limited income, I hope it will not be me as I fear. I know that electric power is necessary for modern life. Both domestic oil and coal are becoming more expensive, and relying on foreign petroleum from the Middle East holds us hostage to foreign agendas. Perhaps it is time to prioritize our energy spending. (**0035-1** [Gardner, David])

Comment: Cost. Duke Power wants customers, 70% in NC and 30% in SC, to pay pre-construction costs through rate hikes. In addition, taxpayers will be asked to take on the entire financial risk through Federal Loan Guarantees. Wall Street won't invest because, as the Congressional Budget Office says, default rate on loans for new reactors is very high well above 50%. This seems like another bail-out in the making. (**0041-6** [McMahon, John])

Comment: Particularly distressing -- and one might even state, "undemocratic" -- is the fact that nuclear energy companies are attempting to place the huge costs on the backs of taxpayers -- even before a plant begins construction and before the final price tag is realized. Wall Street won't risk investing in such stations and insurance companies won't risk insuring them. These facts should tell us loudly and clearly that such projects are unwise and not to be subjected to taxpayer risk. (**0046-3** [Southworth, Win])

Comment: My position [opposition] is based on... The cost of the project which DUKE ENERGY would encumber on the heads of it's customers even BEFORE it's completion. (**0047-3** [Lauden, Loy])

Comment: The price tag for the two nuclear reactors at Lee has grown from $11 to $14 billion. Duke Power wants customers to pay pre-construction costs through rate hikes in addition to taxpayers shouldering the entire financial risk through Federal Loan Guarantees. Another Bail-Out in the making! Wall Street won't invest because as the Congressional Budget Office says, default rate on loans for new reactors are very high, well above 50%. (**0048-6** [Skeele, Michele and Skip])

Comment: There is no way that nuclear power plants can be developed or built without massive subsidies from the government. (**0051-4** [Oehler, Susan])

Comment: Duke wants its customers, 70% of whom are in NC and 30% in SC, to pay pre-construction costs through rate hikes--paying for a product that they may or may not receive in the future. Through Federal Loan Guarantees, Duke would be bailed out if the plants wind up not being built and rate increases would not be refunded, even though the default rate on loans for new reactors is above 50%. (**0055-3** [Schneyer, Julie])

Comment: Regardless of what Duke and Progress Energy may tell you, this is not a cost effective way to supply the Upstate with power. (**0056-2** [Rhyne, Faith Rachel])

Comment: How can the inevitable costs clearly greater than $12 billion, largely underwritten by public and ratepayer funds, be justified, when more economical alternatives for providing electrical energy needs are available? (**0058-1** [Patrie, MD, MPH, Lewis E.])

Comment: The collosal cost of building one of these plants should also be considered, particularly when one considers the fact that new energy technologies that could come on line in the foreseeable future will render them obsolete, in which case the investors will not get paid back. (**0063-7** [da Silva, Arjuna])

Comment: The collosal cost of building one of these plants should also be considered, particularly when one considers the fact that new energy technologies that could come on line in the foreseeable future will render them obsolete, in which case the investors will not get paid back. (**0076-6** [Anonymous])

Comment: Cost: The price tag for the 2 nuclear reactors now stands at $14 billion; and could rise further. Duke Power wants customers to pay this. Federal loan guarantees? The default rate is high. Is this where the U.S. should spend its monetary resources when we have so many other needs for infrastructure, housing, environmental protection? (**0082-3** [Karpen, Leah R.])

Comment: I believe that the fact that nuclear facilities are too risky to be insured by private insurers means that the U.S. government takes all the risk, in other words, the public takes the risk-this in addition to having to pay for its installation in the first place. (**0083-5** [Broadhead, Susan])

Comment: [There are many other decisive reasons to stop the proposed plant, including...] ...the exorbitant cost... (**0083-8** [Broadhead, Susan])

Comment: Construction costs of nuclear facilities are often 7 times estimates. Construction times are 2 times or more than estimates. These all show up as costs that are ultimately borne by we taxpayers. (**0093-3** [Howarth, Robert F.])

Comment: Economics I believe investing millions of dollars required to bring on line a nuclear power plant is not a good investment. History demonstrates that cost always exceeds initial estimates, financing is dependent on government subsidy in the form of liability insurance, and the 5 to 10 year or more construction time is too long. (**0093-5** [Howarth, Robert F.])

Comment: [There are many other decisive reasons to stop this plant, including] ...the exorbitant cost... (**0098-7** [Broadhead, Susan])

Comment: And it [nuclear power] is subsidized with public monies against the will of the majority of citizens, a massive welfare program. (**0100-5** [Richardson, Don])

Comment: Rate payers and taxpayers should not have to pay for a plant they do not want and Wall Street won't touch! (**0112-10** [Andrews, Josephine] [Anonymous] [Beattie, Kathryn E.] [Boever, Virginia] [Boyle, Ella] [Brogan Prindle, Cathleen] [Davis, John] [Flores, S.] [Hamahan, Clare] [Keil, A. Eugene] [Leverette, Will] [Peterson, Harry] [Peterson, Martha J.] [Rittenberg, David] [Rustin, K.])

Comment: This is not to mention the fact that that given cradle-to-grave analysis, nuclear power is simply not very cost-effective. (**0116-5** [Schmitt, Daniel])

Comment: When insurance and responsible waste management are factored in, nuclear power is most likely to be prohibitively expensive. (**0117-10** [Crissey, Brian])

Comment: Nuclear power is allegedly a cheap form of electricity, but the playing field is not level. The public is not interested in bailing out an uninsured nuclear accident, so the cost of sufficient insurance needs to be included, which might be about $4 billion annually, if Duke's rates are similar to my fire insurance. (**0117-6** [Crissey, Brian])

Comment: The problem of financing nuclear reactors and the expensive equipment and backup systems to limit the dangers of both routine and accidental releases of radioactivity into the air, the soil, and the water. (**0119-1** [Thomas, Ruth])

Comment: [The following problems are among those we have identified:] The cost of new equipment and additional risk-reduction measures which Fukushima made us aware that we need. (**0119-12** [Thomas, Ruth])

Comment: The problem that Duke Power wants to charge rate-payers for these pre-construction activities without any guarantee that its customers will ever receive electricity from the proposed plant. For example, the Cherokee plant was never finished at this same site, after many millions of dollars had been spent. (**0119-19** [Thomas, Ruth])

Comment: Expense - With the merger of Progress Energy and Duke, we will all be footing the bill. (**0122-4** [Justice, Cynthia and Michael])

Comment: And speaking of subsidizing, why is the public expected to subsidize a risky, expensive investment by Duke Energy? When they finish, if they do, they will still charge the public whatever they want for the privilege of paying for nuclear energy? Duke Energy will profit and the rest of us will pay unwillingly as a matter of regulation. Perhaps one has to be a millionaire to be considered an "investment partner" in a risky venture and reap benefits if it pays off. The public is just being used and will not reap any monetary benefits, but will certainly pay in rate hikes and in risk to health and safety. No increase in power bills for corporations using public money for their own profits! (**0132-5** [Cahill, Joanne])

Comment: Duke wants its customers to support the huge $11-$14 billion price tag for this project. This BURDEN it purports to place in the current depressed economy ON ITS CUSTOMERS to support its own expansion and profits is nothing less than UNCONSCIONABLE! Allowing these plans to go forward will be allowing another BAIL-OUT! (**0133-4** [Christopher, Lucy D.])

Comment: Section 10.6.2.1, Page 10-30, Lines 6-9: The transmission costs are included in the overall $11 billion cost. (**0134-87** [Fallon, Chris])

Comment: I am a resident of Buncombe County, NC and a customer of Progress Energy who is attempting to merge with Duke. If that happens, I will be among them any forced to bankroll this unsafe, unprofiable technology through Forced increases in my electric bill. (**0140-2** [G., Edith A.])

Response: *The NRC is not involved in establishing national energy policy. Rather, it regulates the nuclear industry to protect the public health and safety and common defense and security within existing policy. These comments express concerns regarding the cost of building a nuclear power plant and what impact potentially increasing costs may have on the financial viability of the company, regional electric rates, and taxpayers. Although the NRC has requirements for licensees (10 CFR 50.75) to provide reasonable assurance that funds would be available for the decommissioning process and to establish financial qualifications (10 CFR*

50.33), general issues related to the applicant's financial viability and rate setting are outside the NRC's mission and authority and are not considered in the EIS. Issues related to taxes, loans, or other governmental incentives for particular types of energy production are also outside the NRC's mission and authority and are not addressed in the EIS. No change was made to the EIS as a result of these comments.

Comment: Today I want to emphasize one overriding concern and that is that we citizens for a long time have been misled by nuclear proponents claiming that nuclear energy is clean and less expensive than other sources of energy. I say this because I recently became aware of EROEI analysis, energy return on energy invested. That analysis illustrates in a study that of 20 feasible energy sources considered, 14 are superior to nuclear. EROEI, also known as Net Energy, has been defined as the energy delivered by an energy-obtaining activity compared to the energy required to get it. In other words, how much energy you get out of something divided by the amount of energy you put into it to get it. This is an overall efficiency assessment and it constitutes a whole system consideration. In the case of nuclear from the extraction of ore at its source, its transportation and processing, the construction and operation of the delivery plant, and the cost of any subsequent waste handling and/or disposal. This, I believe, is looking at the whole picture, the way it really is. (**0012-13-1** [Howarth, Robert F.])

Comment: I contend that the EROEI analysis should be applied to all projects, especially those that are dependent on taxpayer support. I am concerned that EROEI appears to have been ignored in your work in the EIS. While I recognize that the mission of NRC is not to determine national energy policy, I do think you would be obliged to recommend the use of EROEI as a powerful tool toward your goal of, quote, recommending a new plan for America's nuclear future (**0012-13-3** [Howarth, Robert F.])

Comment: As far as the economics, I believe that investing millions of dollars required to bring online a nuclear power plant is not a good investment. History demonstrates that cost always exceeds initial estimates, financing is dependent on government subsidy in the form of liability insurance -- we heard about that already today, Price Anderson, what-have-you -- and the five to ten year or more construction time is too long. Other alternative means of power generation can be brought online in less time, provide many more construction jobs for many more companies, are less risky, and do not require a large taxpayer liability subsidy, and do not hold a threat to my health, your health, our children's health and ecological health that is posed by the operation of nuclear plants and the centuries of storing toxic radioactive waste. (**0012-13-4** [Howarth, Robert F.])

Comment: Concern Today I want to emphasize the overriding concern that we citizens have been misled by nuclear proponents claiming that nuclear energy is clean and less expensive than other sources of energy. This is revealed by EROEI analysis, Energy Return on Energy Invested ', illustrating that of 20 feasible energy sources considered, 14 are superior to nuclear. EROEI, also known as Net Energy, has been defined as "the energy delivered by an energy-obtaining activity compared to the energy required to get it". This overall efficiency assessment constitutes a whole system consideration from the extraction of ore at the source, its transportation and processing, construction and operation of the delivery plant, and cost of any subsequent waste handling and/or disposal. This I believe is looking at the "whole picture" in the way it really is. A carbon footprint comparison shows nuclear as having the 3rd highest carbon footprint among the same 20 candidates following only conventional coal and tar sands. I contend that EROEI should be applied to all projects, especially those dependent on taxpayer support. I am concerned that EROEI appears to have been ignored in your work. While I recognize that the mission of BRC is not to determine national energy policy I do think you would be obliged to recommend the use of EROEI as a powerful tool for your goal of "recommending a new plan for America's Nuclear Future". (**0093-1** [Howarth, Robert F.])

Comment: The position of short term bottom line profit thinking proponents of nuclear relies on huge taxpayer supported government subsidies for liability insurance, and on a narrowly defined "partial system" efficiency assessment. Rather we must look at the "whole picture" the way it really is using EROEI. (**0093-4** [Howarth, Robert F.])

Comment: Whatever it costs to do it right [i.e., dispose of spent nuclear fuel] is the cost that needs to be included, before anyone alleges that nuclear power is cheaper than energy efficiency or solar. (**0117-5** [Crissey, Brian])

***Response**: The level of detail in the EIS for the comparison of the relative benefits and costs of the proposed project is consistent with the staff's charge under NEPA and its own guidance. The relative cost and efficiency of alternative energy sources was not considered in Section 9.2.5 because no alternative energy sources were determined to be feasible and environmentally preferable. The comments did not provide any information that changed the results of that analysis. Therefore no change was made to the EIS.*

Comment: Additionally, nuclear power plants have the lowest electricity production cost since 2001 when compared to other options such as coal, natural gas, and oil, which helps -- this helps keep customers' electricity rates lower. (**0013-4-3** [Fallon, Chris])

***Response:** This comment expresses support for nuclear power in general. No change was made to the EIS as a result of this comment.*

Comment: And the Japanese, who have been dealing with earthquakes forever, have major earthquakes all the time and their buildings sway back and forth on big shock absorbers, their design was safe and Fukushima was a major disaster amounting to at least $235 billion so far and still counting, getting larger because there's going to be Fukushima disease, there's going to be genetic downsides to this, it's going to go on and on, get worse and worse. So don't worry about it, there's insurance. 1957 Price Anderson Act limits the liability of the nuclear industry to $11 billion, after which what do you have? Bailout. Who's in favor of a bailout proposal for the insurance for the disaster possibility for this plant? How many of those politicians running in the State of South Carolina right now come out and say, Well, I'm really in favor of bailouts? No. Bailouts are not good. You've got a 10 percent, 5 percent, 10 percent coverage of the potential disasters from something like Fukushima happening here. Now, Fukushima was $235 billion and counting, they had four of the six reactors in operation, two of them would be accounted for with the plant here, so maybe half of the damages at Fukushima could be estimated, $117 billion, maybe $120 billion. If you're covering maybe 10 percent of that with the Price Anderson Act, you basically have no insurance plus bailout, and that doesn't work. (**0012-8-6** [Crissey, Brian])

Response: *The NRC does not consider a number of issues in its environmental reviews for licensing actions, but does address safety, security, and emergency preparedness issues in the safety review that the agency conducts in parallel with the environmental review. No change was made to the EIS as a result of this comment.*

Comment: So anyway, when you look at the price issues, imagine that what's being discussed here is really not honest, these are not the honest prices. It doesn't include proper management of the waste and it doesn't include proper paying for evacuations and things like this. There are things that are missing in the prices. (**0012-8-7** [Crissey, Brian])

Comment: There are so many concerns about producing power with nuclear energy from the fact that the AP1000 isn't in operation anywhere at this time to the cap on liability. If anything goes wrong, which is 12.8 -- costs 14 billion to build the plant, but if anything goes wrong and the plant impacts, let's say, 300,000 people at $12.8 billion that's like $44,000 a person for loss of your land or your property. (**0013-26-1** [Sloan, Judie])

Comment: [Before acting on this proposal, adequate AND PUBLIC review should include:] The lifetime costs of the different approaches should be calculated, including prevention and remediation of environment damage. The lifetime costs should be borne by the company undertaking the project, rather than users or the community at large. (**0021-5** [Rinsler, MD, Steve])

Comment: The problem of escalating costs of building the proposed Lee Station as well as increased costs for transportation, storage, and disposal. (**0119-20** [Thomas, Ruth])

Response: *The NRC does not consider a number of issues in its environmental reviews for licensing actions but does address safety, security, and emergency preparedness issues in the safety review that the agency conducts in parallel with the environmental review. The NRC conducts a benefit-cost analysis during the environmental review. It requires financial assurance for decommissioning for all applicants, who also must carry nuclear accident insurance under the Price-Anderson Act. The comments did not provide any information that changed the results of that analysis. Therefore, no change was made to the EIS as a result of these comments.*

Comment: Uranium is not a sustainable commodity. (**0024-6** [Whitefield, Anne])

Response: *This comment provides general information in opposition to nuclear power. It provides no specific information related to the environmental effects of the proposed action and will not be evaluated in the EIS. The comment did not provide any information that changed the results of that analysis. Therefore, no changes were made to the EIS.*

E.2.25 General Comments in Support of the Licensing Action

Comment: And last but not least, I live right here in Cherokee County, I live on the Broad River, I live right across from where this thing is going to be built, so safety and environment are, of course, important to me personally as well as professionally here in town. I've personally worked with folks from Duke Energy, I've seen their commitment to excellence, and I have the utmost faith in them that they're going to do what is right to continue to be able to provide low cost, safe, reliable energy for us in the future. (**0012-17-2** [Cook, Jim])

Comment: My third point is that this site will be safe, clean and environmentally friendly. Citizens wish to live and businesses seek to operate in areas that are clean, safe and environmentally sound. These are also key factors affecting the region's quality of life, as I'd mentioned earlier. In addition to being an outstanding corporate citizens, Duke Energy has a good reputation for operating safely and for protecting the environment in the regions in which they operate and serve. (**0012-18-3** [Youngblood, Rob])

Comment: Nuclear energy currently plays and will continue to play a key role in meeting our nation's electricity needs. Duke Energy remains firmly committed to nuclear energy and to keeping Lee Nuclear Station an option for our customers in the future. Thank you once again for giving me this opportunity. (**0012-2-4** [Jamil, Dhiaa])

Comment: I will say this, if you've got to look at things like safety and health, which this organization should do and which I have spent a lot of time doing through my career, there's no better place to start than Duke Energy. Again, I regulated them. I've worked with them over time, I'll admit that up front and disclose that to you, but I've also regulated them, and they set the standard for health and safety. They have reliably and safely operated one of these facilities just down the road from where I was born and raised in Greenville County. They've operated one over in Oconee County for a long time, no issues. (**0012-9-5** [Gossett, Lewis])

Comment: Also, the community involvement Duke provides is being shown greatly throughout the Carolinas, and we have a great history -- Duke has a great history of community service and more areas -- more people in the area will offer more community service. (**0013-17-3** [Reichenbach, Adam])

Comment: And we feel that Duke Power will be -- or Duke Energy -- it used to be Duke Power when I was growing up. Duke Energy will be a good steward of our natural resources. (**0013-2-2** [Moss, Representative Steve])

Comment: Because with their history of environmental stewardship and what they've done in the communities we look forward to having Duke Energy as a neighbor. (**0013-2-5** [Moss, Representative Steve])

Comment: I mean, this is a great thing for Cherokee County. This is a blessing. Cherokee County has been blessed to have this surplus that we've had, but this is just a blessing to where we're going to be able to give employees raises, we're going to be able to create revenue, infrastructure for this -- and we just welcome Duke. I mean, one of the duties that we do take on as an elected official is to create jobs, to create revenue, to create working partnerships with these companies that come in there. And it's our duty. We wouldn't let anything come to Cherokee County that's not safe. I don't think the NRC would do that either. But, you know, that's where the Council stands. We support this whole-heartedly and we welcome Duke to Cherokee County. (**0013-3-1** [Spencer, Tim])

Response: *These comments express support of the Lee Nuclear Station COL application and Duke Energy, but do not provide any specific information relating to the environmental impacts of the proposed action. No change was made to the EIS as a result of these comments.*

Comment: You have my backing on these measures. (**0010-1** [Cox, Judith])

Comment: We [South Carolina Chamber of Commerce] strongly encourage continued forward progress on the construction and operating license to Duke Energy in a timely manner. (**0012-5-6** [Rawl, Otis])

Comment: But I support this project 100 percent. (**0013-2-1** [Moss, Representative Steve])

Comment: GO FOR IT! The sooner we learn about the safeness of Nuclear power the better! YOU have MY VOTE. (**0036-1** [Richardson, Ed])

Response: *These comments express general support of Duke's COL application. No changes to the EIS were made as a result of these comments.*

Comment: I believe the Lee facility will be the most efficient and less environmentally impactful situation we have to sustain our economy, security and overall quality of life we now enjoy. (**0012-16-4** [Farris, Mark])

Comment: I am the president of our [York County] chamber of commerce. We have 800 business members and represent a broad spectrum of businesses actually throughout York

County. I'm here to speak on behalf of the project and in support of the NRC's findings that there are no environmental impacts that would preclude the issuing of the licenses for the two new reactors at the Lee Nuclear Station. (**0012-18-1** [Youngblood, Rob])

Comment: We've also worked to ensure safety and security will be our highest priority for this proposed station just as it is for our current nuclear stations. Following the tragic events in Japan last year after the earthquake and the devastating tsunami, the nuclear industry, including Duke Energy, undertook immediate actions and continues today implementing longer term recommendations to ensure our nuclear stations remain in a high state of readiness to respond to potential emergency events. This focus on safety will continue as our top priority. (**0012-2-3** [Jamil, Dhiaa])

Comment: I'm here representing 60,000 businesses and 73 state chambers of commerce across the state in support of the Lee Nuclear Station project moving forward. There's no one single factor or answer for solving our energy needs. We know that we've got to continue to work on renewables as well as conservation efforts, but the creation of nuclear power as a sustainable energy source is promising and will be one of South Carolina's greatest assets of the future. (**0012-5-1** [Rawl, Otis])

Comment: First I want to talk about the nuclear safety. Safety culture remains the number-one focus of any nuclear plant across the country. Examples of how we do that is our human performance tools, like take-a- minute pre-job briefs, which we do every day before we do any job, before we do any task. Even in the office we tend to do things like this. We also review operating experience. We continuously strive for improvement to get better safety every day. Nuclear plants are some of the safest industrial facilities, and there have been zero fatalities in the U.S. due to exposure of radiation due to commercial nuclear power plant incident. Nuclear plants survived some tough natural disasters in 2011 as we've heard before -- record flooding in Nebraska, tornadoes in the southeast, earthquake and hurricanes on the east coast. And through all the natural disasters there has been no problem with safety. We've had safe shutdowns whenever we needed too. There's been no breach in containment. There's been no release to the public. We proved that we have a robust design in all these reactors. The AP1000 specifically has been designed so that it can be automatically shut down without the need for off-site power. I saw a quote today from our -- from Duke's chief nuclear officer, Dhiaa Jamil, and he said that our nuclear plants were safe a decade ago and will be even safer as the years pass. (**0013-17-1** [Reichenbach, Adam])

Comment: In our planning for new nuclear we continue to focus on operational safety and security as our top priority just as we do at all the Duke energy operated stations today. Following the catastrophic earthquake and destructive tsunami in Japan last year the nuclear industry across the world, including Duke Energy, undertook immediate actions and continues to identify and implement additional recommendations to ensure our nuclear plants are always in a high state of readiness to respond to any potential emergency events. (**0013-4-4** [Fallon, Chris])

Comment: I am in full support of approving the combined licenses application for Lee Nuclear Station Units 1 and 2. I do not believe the environmental impacts outweight the advantageous outcomes - jobs; alternative energy source - for this and surrounding counties. (**0091-1** [McFadden, Cindy])

Response: *These comments provide general information in support of the Lee Nuclear Station COL application. They do not provide any information which would require changes to the EIS.*

E.2.26 General Comments in Support of Nuclear Power

Comment: I certainly don't want to turn over a country that has depleted all of its methane because people were afraid of something that even at Fukushima not one single person, not one was killed by radiation, not one. 18,000 people were killed by tsunami, a huge swath of Japanese territory was destroyed by a tidal wave, all of the video that you keep seeing is video of the damage done by salt water, not by radioactive material. (**0012-12-7** [Adams, Rod])

Comment: One of the things that I learned when I was very young was that my father brought home this little pellet -- actually it wasn't this pellet, because I lost the pellet he brought me home. But this pellet represents the size of a fuel pellet. It's simulated -- of course, I can't bring uranium into this building -- but it is a nine gram pellet. It has the same energy value in our current basically second generation technology as a ton of coal. That's a pickup truck load of coal, a big pickup truck load of coal. The submarines I used to serve on operated for 14 years on a single load of fuel. The current submarines that we build today operate for 33 years on a single load of fuel. The power they produce is clean enough to run inside a submarine sealed up full of people, making fresh air, fresh water, all the air conditioning, all the power that we need. (**0013-12-1** [Adams, Rod])

Comment: Not one single person has ever been killed by a nuclear power plant in the U.S.--commercial nuclear power plant in the U.S. And nobody was killed by radiationat Fukushima. (**0013-12-3** [Adams, Rod])

Comment: Humans can't control it. Yes, humans do make mistakes, but humans canoperate power plants safely and reliably because we do it, we do it carefully,we have a lot of backups, we have backups to the backup, we have people thatfollow procedures, we have carefully trained people, and, yes, we do have bigbrains, darn it. (**0013-12-5** [Adams, Rod])

Comment: Let's talk about Fukushima for one second before I pass the mike. Right now the -- one of the greatest tragedies I think is the thousands upon thousands of people that have lost their lives. Over 15 and a half thousand people died in that. Over 3 and a half thousand were missing -- still are. And over 5 and a half thousand also are injured. How many people died from radiation poisoning? None. The four people that died, two died in drowning in the cooling towers. One person died in the crane, and one individual died of a heart attack. The true tragedy is that we're focusing on nuclear versus the people that have lost their lives. (**0013-6-1** [Baker, Kasey])

Comment: I DO SUPPORT NUCLEAR POWER and have no financial investment in it either. I do not spend my time in meetings in protest or support but like to make my support known. (**0042-1** [Paterson, Wallace])

Comment: I am in strong support of building nuclear power plants in the US. (**0054-1** [Gaddy, Ron])

Comment: In my opinion, I don't think the US can afford not to start building nuclear power plants. We have been asleep at the wheel for 30 years. It's time to start building nuclear plants in all states. (**0054-5** [Gaddy, Ron])

Response: *These comments express general support of nuclear power. No changes to the EIS were made as a result of these comments.*

Comment: I found nuclear plants in my venue to be a good neighbor and friendly to the environment. And the new proposed nuclear plant will be a state-of-the-art component, the Westinghouse AP1000 that has been designated here tonight. And the state of South Carolina, by designation of a concurrent resolution, has found nuclear energy to be the source of the future. And I'd like to read the concurrent resolution which was adopted June 1. 2006. It was first introduced and read May 31, 2006. To advance the need for electric utilities to build new nuclear power plants in South Carolina and to urge the Office of Regulatory Staff and the Public Service Commission to encourage such consideration. (**0013-1-1** [Moss, Representative Dennis])

Comment: Whereas, the United States Congress passed a 2005 energy bill providing a number of incentives that function to encourage electric utilities to pursue nuclear energy to reduce dependence on energy supplies from unstable parts of the world, and, Whereas, the Office of Regulatory Staff and Public Service Commission are the appropriate state agencies to promote the construct of nuclear power plants by South Carolina utilities and to architect the necessity for utilities to take responsible and reasonable steps to maintain the nuclear generation option in South Carolina. Now, therefore, be it resolved by the House of Representatives, the Senate concurring, that the General Assembly of the State of South Carolina by this resolution advance the need for electric utilities to build nuclear power plants in South Carolina and urge the Office of Regulatory Staff and the Public Service Commission to encourage such consideration. Be it further resolved that a copy of this be forwarded to each member of the Public Service Commission and to the executive director of the Office of Regulatory Staff. Adopted June 1, 2006. I represent Cherokee County in the House of Representatives, where this proposed plant is physically going to sit. The McKowns Mountain community of Cherokee County, adjoining York -- Western York County, which also represent and touching Western Chester County that I represent, and the constituents and voters in my area do not oppose this project. (**0013-1-5** [Moss, Representative Dennis])

Response: *These comments provide general information in support of nuclear power via the recital of a resolution passed by the General Assembly of South Carolina in 2006. No changes were made to the EIS as a result of these comments.*

E.2.27 General Comments in Opposition to the Licensing Action

Comment: I request your strong opposition to the William States Lee III Nuclear Station Units 1 and 2 licenses. (**0001-1** [Stoll, Irene])

Comment: We ask that this nuclear power plant not be built. Please do not allow any more of these potentially disastrous facilities to be built. (**0002-5** [Smy, Gayle and Allison])

Comment: I am opposed to the proposed nuclear plant in Gaffney, SC. (**0003-1** [Arnold, Debbie])

Comment: I live near Gaffney and do not want this facility in my backyard. (**0003-4** [Arnold, Debbie])

Comment: I am writing to oppose Duke Energy's combined license application(COL) to build William States Lee Nuclear power Station in Gaffney SC. (**0004-2** [Cunningham, Kristine])

Comment: No nuclear power near asheville please.... too expensive and too dangerous.... (**0006-1** [Flaherty, David])

Comment: No, NO, and NO, to the Duke's Lee Nuclear Station. (**0007-3** [Tinnaro, Heather])

Comment: I strongly oppose any new nuclear power plant construction, but especially ones that are only 60 miles from my home! Have we learned nothing from history??? (**0011-1** [Miller, John C.])

Comment: I oppose the construction of Lee Nuclear Station and will continue to fight for clean energy options. (**0013-36-2** [Cranford, Kelley])

Comment: We strongly oppose the building of a Nuclear Station in Gaffney, SC, or any other place. (**0014-1** [Wilson, Rev. Mason and Barbara S.])

Comment: As a Henderson County resident, and mother of two young children, and member of a vital community, I am deeply opposed to a nuclear power plant near here. (Gaffney, SC) Please consider my opposition, and the opposition of many who live here because it is a healthy place to be! (**0015-1** [Schott Cummins, Gretchen])

Comment: Achieving results which produce the greatest good for the most citizens takes determination in the face of pressure from many disparate interests. But this is a real "no-brainer." There is so much on the negative side of this project that approval for this project would be counter-intuitive. Please don't allow this nuclear plant application to proceed. (**0017-11** [Morgan, Tom and Barbara])

Comment: I am writing to voice my opposition to the propose nuclear plant in Gaffney, SC. As a nearby resident, tax payer parent and grandparent, this is not a healthy option for our region. (**0018-1** [Vestal, Majorie])

Comment: I am communicating to you my strong opposition to the proposed William States Lee Nuclear Plant, Gaffney, NC. My wife and I, our daughter, 3 month granddaughter, and son in law live in Asheville NC, 60 miles Gaffney SC. This nuclear plant proposal is WRONG for many reasons... (**0019-1** [Doebber, Tom])

Comment: For these major reasons and others, the plan for the William States Lee Nuclear Plant must be stopped now. (**0019-7** [Doebber, Tom], **0020-7** [Klein, Art and Michelle])

Comment: I am communicating to you my strong opposition to the proposed William States Lee Nuclear Plant, in Gaffney, NC. My wife and I live in Asheville NC, 60 miles from Gaffney SC. This nuclear plant proposal is WRONG for many reasons... (**0020-1** [Klein, Art and Michelle])

Comment: NO!!!! to Nuclear Power Plant in Gaffney, SC. No! No! No! (**0023-1** [Brackett, Cheri])

Comment: I am very much agains't the proposal. (**0025-1** [Dixon, Mary])

Comment: Please do not build this facility. (**0025-4** [Dixon, Mary])

Comment: I am seriously against the plans for building a new nuclear power plant in Gaffney, SC or anywhere for that matter. (**0027-1** [Nord, Felice])

Comment: I would like to express my opposition to construction of Units 1 and 2 in Gaffney, South Carolina. (**0030-1** [Swing, Carol])

Comment: I would like to go on record as objecting to the proposed nuclear facility in Gaffney, SC. (**0033-1** [Gardner, Janet])

Comment: I am writing to express my opposition to the proposed William States Lee nuclear plant in Gaffney, South Carolina. (**0041-1** [McMahon, John])

Comment: As a resident of Hendersonville, NC, I want to register my opposition to the plan to construct a nuclear power plant in Gaffney, Sc. Nuclear power is toxic and outdated. (**0045-1** [Mewborne, Janice])

Comment: I am opposed to building William States Lee III Nuclear Stations 1 &2. (**0049-1** [Ruthye100, You Tube Service])

Comment: I am writing tonight to tell you that I OPPOSE a new nuclear power plant in Gaffney, SC. (**0051-1** [Oehler, Susan])

Comment: As a Duke customer and North Carolina resident taxpayer, I urge you to turn down the proposed W. S. Lee nuclear plant near Gaffney, South Carolina. (**0052-1** [Boots, Debby])

Comment: I am urging the Nuclear Regulatory Commission not to approve these permits (**0055-1** [Schneyer, Julie])

Comment: I would like to ask that you seriously consider denying the permit for two additional reactors in Gaffney, SC. (**0056-1** [Rhyne, Faith Rachel])

Comment: I request as a concerned citizen that you do NOT approve permits for the William States Lee III Nuclear Station! (**0059-1** [Raleigh, Carolyn])

Comment: I am here to express my concern about William States Lee III Nuclear Station. (**0062-1** [Smith, Joy])

Comment: We are writing to OPPOSE the proposed building of two nuclear power stations, called the William States Lee Nuclear Facility, in Gaffney, SC. (**0063-1** [da Silva, Arjuna])

Comment: We are writing to OPPOSE the proposed building of two nuclear power stations, called the William States Lee Nuclear Facility, in Gaffney, SC. (**0076-1** [Anonymous])

Comment: I want this Nuclear Plant stopped. (**0077-3** [Gilbert, Grace])

Comment: Please stop this Nuclear Plant construction. (**0077-5** [Gilbert, Grace])

Comment: I am writing to express my opposition to the proposed William States Lee III Nuclear Station Units 1 and 2. (**0079-1** [Schmitt, Brynn])

Comment: I am writing you to ask you to stop the approval of William States Lee III Nuclear Station Units 1 & 2. (**0081-1** [Severin, Patricia])

Comment: I am writing to express my strong opposition to the proposed William States Lee Nuclear Plant. (**0083-1** [Broadhead, Susan])

Comment: Please decide not to build the proposed plant. (**0083-10** [Broadhead, Susan])

Comment: I am opposed to the proposed William States Lee Nuclear power Plant. (**0084-1** [Lemoing, Melissa])

Comment: I wish to refute the conclusion that the power station is a good idea. (**0085-1** [Allison, Patricia])

Comment: PLEASE VOTE AGAINST building two new nuclear plants in Gaffney, SC. (**0088-1** [Lovinsohn, Ruth])

Comment: I am strongly opposed to the proposed William States Lee Nuclear Plant. (**0098-1** [Broadhead, Susan])

Comment: I urge the NRC to say NO to this proposed plant. (**0099-4** [Greenberg, Lori])

Comment: I OPPOSE this license application! (**0105-2** [Craig, Anne])

Comment: STOP THIS PLANT! (**0108-3** [Fisk, Bill])

Comment: I am writing to opposed Duke Energy's combined license application (COL) to build William States Lee Nuclear power plant in Gaffney, SC. (**0112-3** [Andrews, Josephine] [Anonymous] [Beattie, Kathryn E.] [Boever, Virginia] [Boyle, Ella] [Brogan Prindle, Cathleen] [Davis, John] [Flores, S.] [Hamahan, Clare] [Keil, A. Eugene] [Leverette, Will] [Peterson, Harry] [Peterson, Martha J.] [Rittenberg, David] [Rustin, K.])

Comment: I am writing as a resident of Buncombe County, NC to request that you NOT approve permits for the proposed William States Lee III Nuclear Plant near Gaffney Units 1 and 2. (**0113-1** [Rose, Katherine])

Comment: I am writing you to register my feelings regarding the proposed building of William States Lee III Nuclear Stations Unit 1 & 2. I AM OPPOSED!!!! It is a BAD IDEA. (**0114-1** [Lovinsohn, Ruth])

Comment: I am writing to oppose the building of the William State Lee III Nuclear Power Plant in Gaffney South Carolina. (**0115-1** [Burnett, Linda])

Comment: Please do not allow this plant to be constructed. (**0115-3** [Burnett, Linda])

Comment: This power plant must NOT be built! (**0116-1** [Schmitt, Daniel])

Comment: ...we adamantly oppose the licensing or building of the Lee Nuclear Stations 1 and 2, or any other nuclear power plants, anywhere.
(**0119-25** [Thomas, Ruth])

Comment: Please do not build a nuclear power plant in the area near Asheville, NC. (**0120-1** [Wilson, Dawn])

Comment: We oppose the nuclear power plant proposal for numerous reasons. (**0122-1** [Justice, Cynthia and Michael])

Comment: I wish to register a firm NO for the planned nuclear power plant in SC. (**0123-1** [Thomas Orengo, Cheryl])

Comment: I am writing to express my sincere opposition to the construction of thisfacility. (**0124-1** [Hayes, MD, J. David])

Comment: Please do not approve the new facility in Gaffney. (**0125-1** [Clere, Daniel])

Comment: I am writing to oppose the construction of two nuclear plants in Gaffney, SC. (**0132-1** [Cahill, Joanne])

Comment: Please oppose the William S. Lee Nuclear Plant. (**0132-7** [Cahill, Joanne])

Comment: My letter speaks to OPPOSITION of the proposed WILLIAM STATES LEE NUCLEAR PLANT. (**0133-1** [Christopher, Lucy D.])

Comment: I am writing to oppose the approval of the proposed William States Lee III Plant in Gaffney, S.C. (**0139-1** [Dailey, Debbie])

Comment: I implore you not to approve the construction of the William States Lee III plant. (**0139-4** [Dailey, Debbie])

Comment: Please do not approve the construction or operation of the proposed William States Lee III Plant. (**0140-1** [G., Edith A.])

Comment: I ask again that you do not issue a construction license for this plant. (**0140-4** [G., Edith A.])

Comment: I am writing to implore you to reconsider building that nuclear (WS Lee III) power plant in upper South Carolina. (**0143-1** [McAfee, Patricia B.])

Response: *These comments express general opposition to the Lee Nuclear Station COLs. No changes were made to the EIS as a result of these comments.*

Comment: Regarding the proposed William States Lee III Nuclear Station units 1 and 2, near Gaffney SC: We are residents of Weaverville NC, which is near the site of the proposed nuclear station near Gaffney, SC and are thus susceptible to being exposed to any unfortunate happenings at this plant. We are very much opposed to having any nuclear plant built in Gaffney, or anywhere else. (**0002-1** [Smy, Gayle and Allison])

Comment: There is no good argument for building this nuclear plant, or any other, and there are many reasons to not do so. The history of the disasters and the ecological problems are sufficient reason to avoid this source of power. (**0002-3** [Smy, Gayle and Allison])

Comment: Please, I implore you to not build this power plant....the lives of millions of people are at stake, and not to count the countless millions of flora and fauna..... Please, I implore you once more.....do not build this power plant...... (**0009-1** [vonSeideneck-Houser, Rebecca])

Comment: I'm here to oppose the building of these enormously expensive nuclear plants at taxpayer expense for all the reasons that were -- have been outlined up to this point. (**0013-16-1** [Zdenek, Dr. Joe])

Comment: I wouldn't want to see that [health impacts from radiation] happen to the citizens of Gaffney and Cherokee County, and I wouldn't want to have it happen to others of us further away from the plant. And I ask you please do not approve this plant. (**0013-33-3** [Broadhead, Susan])

Comment: With the immense amount of scientific evidence as well as experiential data from scores of nuclear power plants around the world confirming how dangerous nuclear power is and always will be in multiple aspects, how can any sane person consider building more nuclear power plants?? As a very concerned resident of nearby Hendersonville, NC, I wish to register strong objection to building a plant in Gaffney, SC (**0016-1** [Howell, Martha N.])

Comment: There is no possible justification for endangering hundreds of thousands of human beings in the radius around Gaffney that will have their health seriously damaged by the production of nuclear power at this proposed facility. I look forward to hearing that this ill-conceived project has been cancelled. (**0016-2** [Howell, Martha N.])

Comment: My wife and I live sixty miles from a proposed nuclear power plant in/near Gaffney, SC. In view of the numerous historic unresolved problems with the use of nuclear fuel for power production, we judge this a dubious, as well as high-risk project. (**0021-1** [Rinsler, MD, Steve])

Comment: Watching NC develop into the next generation of possibilities and opportunities is clearly exciting. But part of what has made this a workable evolution are some specific characteristics this area offers. Asheville is growing and touted as one of the best places to retire because people are drawn to the beauty, consciousness and weather. By proposing to build a nuclear plant this close to Asheville, and in the range of three major colleges, you are seriously threatening 2 of those premises, Please, I beg of you, reconsider. (**0040-1** [Siler, Jill])

Comment: I cannot state strongly enough my opposition to Duke Energy's Lee Nuclear Station license application. Such ultra-problem laden power stations must not be allowed to lessen the future health -- economic and potentially physical -- or this generation and future generations of our citizens. (**0046-5** [Southworth, Win])

Comment: Its design is questionable and presents risks to water, air, the surrounding land and human health. (**0052-3** [Boots, Debby])

Comment: We don't want the nuclear industry in our area and although I am not a resident of South Carolina, I am too close to Gaffney and thus terribly concerned about the safety of such a potentially deadly boondoggle. (**0060-2** [Craig, Tom])

Comment: I beg you to not give in to the lobbying of money-making Duke Energy, and instead encourage those who are developing carbon-free, nuclear-free energy, so that we won't ever again suffer a Three Mile Island or Chernobyl or Fukushima. (**0089-1** [Thomas, Ellen])

Comment: Many of us who are parents and grandparents say the chances of failure of this newly designed AP 1000 are just too high. (**0104-2** [Bliss, Rachel])

Comment: ...we do not trust the safety of this plant's untested reactor, with Gaffney being just one of the nuclear sites where this reactor will be used. (**0104-6** [Bliss, Rachel])

Comment: No to raising my rates for creating nuclear waste & destruction in my nameor my children. (**0118-1** [Williams, David])

Comment: It is much too close to Asheville where I live and too close to people in general. (**0123-2** [Thomas Orengo, Cheryl])

Comment: I strongly urge you to deny this license and help to move the country toward a safe, easily protected, environmentally friendly, energy solution.
(**0124-7** [Hayes, MD, J. David])

Comment: I am opposed to this plant and all nuclear power. Future generations should not have to bare the burden of our current consumption by babysitting our spent fuel rods. We should take responsibility for such things now by not producing them in the first place. Please do not move forward with the William States Lee plant in Gaffney, SC.
(**0125-3** [Clere, Daniel])

Comment: I feel this [waste disposal] is the major problem with nuclear power. It is the worse possible course of action. This plant should not be licensed. It is immoral to force generations to come to deal with the waste from the process.
(**0145-1** [Macko, Karl])

Response: *These comments provide general information in opposition to Lee Nuclear Station. The NRC carefully reviewed Duke's COL application against its regulations that are intended to protect public health and safety and the environment. These comments do not provide specific information related to the environmental effects of the proposed action, and no changes were made to the EIS as a result of these comments. Specific comments and NRC staff responses regarding benefit-cost, surface-water use, energy alternatives, the storage of spent fuel, the severe accidents analysis in the EIS, and plant safety are addressed in other sections of Appendix E.*

E.2.28 General Comments in Opposition to the Licensing Process

Comment: Whereas the NRC has a clear record of putting profits ahead of people and production ahead of health and safety. (**0013-11-1** [Smith, Coleman])

Comment: The Nuclear Regulatory Commission is supposed to pay attention to the dangers of nuclear energy. To rubber-stamp Duke Enegy's proposal is a betrayal of your responsibility to keep our country and our region safe. (**0089-3** [Thomas, Ellen])

Comment: It is your job to protect us. It is your job to get educated enough to be able to protect us. For obvious reasons, you cannot educate yourself by listening to the industry; you need to listen to the scientists who do not stand to profit from promoting (or banning) nuclear power. Please listen to the doctor Helen Caldicott who has been trying to get us all to listen to the dangers of nuclear power: www.helencaldicott.com. Please also familiarize yourself with the work of scientist Amory Lovins at the Rocky Mountain Institute: www.rmi.org

You have a very important job, a job that you cannot just float through to get a paycheck -- you have a moral duty to wake up to reality and see how incompatible to life nuclear power is. It is your job to understand that we cannot afford the risks of nuclear anymore, and you must act on that understanding. (**0121-5** [Wallace, Kristine])

Response: *These comments express opposition to the NRC's COL application review process. The NRC carefully reviewed Duke's application against its regulations that are intended to protect public health and safety and the environment. One commenter cites Amory Lovins' work at the Rocky Mountain Institute. Lovins advocates efficient use of electricity and reliance on renewable energy sources such as wind, solar, geothermal, etc. Other comments on the EIS regarding energy alternatives and NRC staff's responses are found in Section 2.28 of this appendix. These comments do not provide specific information related to the COL process or environmental effects of the proposed action, and no changes were made to the EIS as a result of these comments.*

Comment: I thought that any nuclear construction was on hold following the disaster in Japan. (**0027-2** [Nord, Felice])

Response: *NRC licensing of new nuclear reactors has not been suspended. Since the nuclear accident at Fukushima first began to unfold, the NRC has been working to understand the events that took place in Japan and relay important information to U.S. nuclear power plant licensees and applicants. Not long after the emergency began, the NRC established a task force of senior NRC experts to determine lessons learned from the accident and to initiate a review of NRC regulations to determine if additional measures should be taken immediately to ensure the safety of U.S. nuclear power plants. The task force issued its report on July 12, 2011, concluding that continued U.S. nuclear plant operation and NRC licensing activities presented no imminent risk. The task force also concluded that enhancements to safety and emergency preparedness are warranted and made several general recommendations for Commission consideration. The NRC (2012d) issued SECY 12-0025, detailing the proposed Orders and required actions in response to lesson learned from Japan's March 11, 2011, earthquake and tsunami. For new reactors and combined license applications (e.g., Lee Nuclear Station), the staff will ensure that the Commission-approved Fukushima actions are addressed prior to licensing.*

On March 9, 2012, the Commission directed the NRC staff to issue immediately effective Orders to U.S. commercial nuclear reactors to begin implementation of several recommendations for enhancing safety at U.S. reactors, based on lessons learned from the accident at Japan's Fukushima Dai-ichi nuclear power plant (see NRC News Release 12-023 at http://pbadupws.nrc.gov/docs/ML1206/ML120690627.pdf). Two of the Orders apply to every U.S. commercial nuclear power plant, including those under construction and the recently licensed new Vogtle and V.C. Summer reactors. The first Order requires plants to better protect safety equipment installed after the September 11, 2001 terrorist attacks and to obtain sufficient equipment to support all reactors at a given site simultaneously. The second Order requires plants to install enhanced equipment for monitoring water levels in each plant's spent fuel pool. The third Order applies only to U.S. boiling water reactors that have "Mark I" or "Mark II" containment structures. These reactors must improve venting systems (or, for the Mark II plants, install new systems) that help prevent or mitigate core damage in the event of a serious accident. Plants have until December 31, 2016, to complete modifications and requirements of all three Orders. The NRC also issued a detailed information request to every operating U.S. commercial nuclear power plant; certain parts of this request apply to reactors currently under construction or recently licensed.

E.2.29 General Comments in Opposition to Nuclear Power

Comment: I would like to express my strong opposition to building a nuclear plant. (**0005-1** [Lewis, Brenda K.])

Comment: We [Blue Ridge Environmental Defense League] oppose the environmental impacts, we oppose the public health impacts, as well as the problematic and dangerous use of nuclear energy in this part of the world. I think we should follow the lead of some of the most advanced technological societies on earth, Japan, Germany, and phase these out, certainly not build a new one. (**0012-11-4** [Zeller, Lou])

Comment: And as a taxpayer, I don't want my money going to support and subsidize dirty toxic energy. Please phase out nuclear. Support viable, sustainable and clean alternatives that also create many more permanent jobs. (**0012-19-5** [Howarth, Irma])

Comment: I'm Katie Hicks. I'm the assistant director of Clean Water for North Carolina, a nonprofit organization working with communities for clean water and environmental justice. We're opposed to the construction of all new nuclear reactors for many reasons... (**0012-7-1** [Hicks, Katie])

Comment: Whereas all nuclear power stations pollute the environment with heat, chemicals, and radiation. (**0013-11-3** [Smith, Coleman])

Comment: Whereas the NRC cannot be trusted to protect the citizens of western North Carolina who live outside the 50-mile radius, Therefore, we the people of western North Carolina question the fairness and the integrity of the Nuclear Regulatory Commission bias of promoting expensive, dirty, and dangerous nuclear energy over affordable clean and safe renewable energy alternatives. As part of the 99 percent we say no nukes. No nukes. No nukes. (**0013-11-8** [Smith, Coleman])

Comment: And, of course, nuclear power plants are all old. They're going to be decommissioned in a short period of time and there's no way that we could possibly replace those nukes faster than they're going to be decommissioned. So nuclear power's going to die anyway. Nukes have already contaminated the planet forever. (**0013-14-1** [Richardson, Don])

Comment: We're committing suicide is what we're doing. We're leaving the planet -- we are going to leave the planet to perhaps the only species that can survive our legacy of radiation -- and that would be the cockroaches. (**0013-14-4** [Richardson, Don])

Comment: You should no longer be in the business of approving new nuclear plants, but instead be in the business of shutting them all down. The production of electricity via nuclear means is irrational. From the mining of the uranium to the transport of the materials to the huge amounts of water used in the energy production to the production of the dangerous waste that has no safe storage nuclear energy is unsafe, unhealthy, and dangerous to life. (**0013-20-1** [Craig, Anne])

Comment: But it is very clear to me that if democracy were to prevail in this country the forces opposed to nuclear energy would win hands down. We have heard some -- I think three proponents of nuclear energy speak up here. We have heard probably 15 opponents speak up here. So if you do the arithmetic it's very clear that for some reason the opponents come out here and the proponents, all of whom I think have connections with the nuclear power industry or with nuclear submarines, at least, all of whom so have some kind of professional connections. And that's not to dispute what they're saying, but they do have those connections. The rest of us are here because we are passionate -- we are passionate. We are determined that we are not going to let this thing be built. We -- some of us were involved in the proposition to nuclear power plants in the seventies. I personally protested at the Seabrook Nuclear Power Plant in New Hampshire several times. We succeeded them in stopping the construction the nuclear power plants. We will do it again. (**0013-21-2** [Norris, Steve])

Comment: And I and ASHE do not believe that nuclear power is a solution to the climate change dilemma or our energy security in this country. (**0013-23-1** [Buscarino, John])

Comment: People -- well, I just am so opposed to this. I live close to this area. I just hope that I'm -- when I'm on my deathbed I don't want my grandchildren coming up to me and saying, Grandma, is this best you could do? Is this the best you could do? And what will I say? Well, you know, we had the brains, we had the innovation, but that nuclear power is so profitable. Well, it's not profitable for human health. (**0013-35-2** [Hammett, Jan])

Comment: For the NRC to state these facts and allow new nuclear plants to be built is immoral and irresponsible. (**0013-7-5** [Sorensen, Laura])

Comment: I live way too close to the southeastern nuclear power plants and I'd like to say something that touches me deeply. Nuclear power -- no thanks. Nuclear power is not the way that we want to go. When I consider the potential of the human experience and the energy that we have to create and the enormous capacity that we have for love then I do have hope for the future. But when I consider the madness of nuclear power and the deadly waste then I feel my core shaking, my heart is pounding, my eyes start watering, and my hope fades. Nuclear power -- no thanks. When I consider our current approach to nuclear power then I have a very difficult time understanding how we got to this place of denial and deceit. How could we so blatantly disregard our responsibility for ourselves and the future? What happened to the respect that we owe those that came before us and what happened to the respect for those who will inherit this place after us? Nuclear power -- no thanks. My frustration and embarrassment can take me to the deepest pits of despair only to find myself with no other choice than recharging my glimmers of hope and climb back up to the edge of sanity. It's in the world of sanity that we must get together. Let the responsibility for the future generation be our guiding principle. We must agree to take care of today's needs in a sustainable manner without jeopardizing the needs of tomorrow. Nuclear power -- no thanks. I implore you, the NRC, the enablers of madness, give us a chance to redeem ourselves as a species and seriously consider the wise guiding principle of love and respect when deciding what we leave behind from a millenia to come. I cannot look my children in the eyes and say, Well, I'm sorry. That was the best we could do. Deal with it. It is just not acceptable. Nuclear power -- no thanks. So pucker up, get your act in gear because now is the time to change course so that our legacy will not be embedded in a history as one of the biggest downfalls of the human experience. Let us change the age of stupid into the age of courage. Be aware that your decisions will affect thousands of generations to come and that now is your big chance to make amends and let our children know that you did have a heart and that you did do your absolute best for humanity. I implore you, my dearest fearful regulators, to please reconsider your role in allowing this nuclear madness to continue and please make a stand for the people. (**0013-8-1** [Sorensen, Ole])

Comment: Please do not build another Nuclear Station! (**0014-3** [Wilson, Rev. Mason and Barbara S.])

Comment: The costs of waste disposal and numerous environmental hazards, plus the many risks just don't make it sensible. (**0027-4** [Nord, Felice])

Comment: I am writing as a citizen of Asheville NC, concerned--outraged that a nuclear power plant is being considered in this region. I would be outraged on behalf of ANY region. Nuclear power has seductive powers to persuade people of its benefits and benign nature, but, like many seductions, its reality is ugly. Why are we building plants when other countries are weaning themselves of this technology? (**0029-1** [Scott, Cathy])

Comment: I am concerned and disappointed to hear of the propsed building of a nuclear plant near Gaffney, SC. I find it quite amazing that people making environmental and life threatening decisions, want to do so with the money provided by those very same people who will be most affected should it go the same way as other nuclear plants around the world, including this country. If my money is to be spent in providing energy, then I want it to be on clean energy where people can live without the threat of someone's thoughtless mistake and the leaking of radiation. (**0032-1** [Watters, Gillian])

Comment: We cannot afford to risk polluting our rivers, releasing radiation and making people fearful of possible dangers. (**0034-1** [Gardner, Janet])

Comment: Nuclear power does not ease the petrolium and gas extraction crisis. (**0037-3** [Collins, Richard])

Comment: Please stop building any more nuclear power plants in the U.S.A. Despite the modern advanced designs offered for these new plants, the health RISKS of radiation effects from accidents is still not acceptable. The recent nuclear accident in Japan has caused Germany and other countries to shut down some of their nuclear plants, and to stop plans for building new plants. So, why does the U.S. choose to ignore world events and the decisions by other countries? We should not accept the health RISKS posed by new nuclear power plants. (**0038-2** [Burt, Rick])

Comment: We should stop all production after seeing the catastrophic problems in Russia & Japan... (**0044-1** [Bertram, Beth])

Comment: Please record my position in which I OPPOSE the proposed nuclear plant being considered at this location. In fact I OPPOSE construction of ANY NUCLEAR PLANT Based on what we now know and what we have always known About nuclear power and that which involves it's creation. (**0047-1** [Lauden, Loy])

Comment: I don't believe nuclear power is worth the kind of risk and human suffering we've seen in recent history! (**0048-11** [Skeele, Michele and Skip])

Comment: Every aspect of nuclear power is a threat to the new energy future this county and world needs to build in order to support a sustainable life for humanity on this planet, from the initial mining of uranium, to the huge amounts of water necessary to cool nuclear reactors, to the unsolved problem of dangerous radioactive waste. (**0055-2** [Schneyer, Julie])

Comment: We don't need nuclear power. It's too dangerous. I'd rather have rolling blackouts due to power shortage than radioactive waste being trucked out of the town I live near. (**0056-6** [Rhyne, Faith Rachel])

Comment: No to nuclear. There are better, safer, more sustainable, and saner solutions. (**0057-1** [DeLap, E.A.])

Comment: It is simply unconscionable to build a new nuclear plant, knowing full well the huge risk it poses to the public. (**0061-1** [Holt, Cathy])

Comment: I am opposed to building more nuclear plants anywhere and especially do not want one less than 100 miles from my home. (**0062-2** [Smith, Joy])

Comment: Need we mention the horrors of Three Mile Island, Chernobyl and Fukushima? The Fukushima disaster alone should be reason enough to put a moratorium on more new nuclear facilities... (**0063-2** [da Silva, Arjuna])

Comment: Nuclear is not the way to go as Fukyshima is one obvious example of this. (**0078-1** [Atanasoff, Mike])

Comment: Mining of uranium is deplorable and the water to cool reactors is wasteful and never anywhere to store the waste. (**0078-2** [Atanasoff, Mike])

Comment: From the information and experiential education we gained through the experience of living within twenty miles of the damaged reactor at Three Mile Island at the time of the accident there, as well as the terror and emotional trauma suffered by my husband, myself and our family at that time, I have absolutely no doubt in my mind that producing electricity by means of nuclear energy is simply a very dangerous and unwise idea. (**0079-5** [Schmitt, Brynn])

Comment: I shouldn't have to be making this comment. Isn't it clear enough yet, or is nuclear energy still the elephant in the room? You should no longer be in the business of approving new nuclear plants, but instead be in the business of SHUTTING THEM ALL DOWN!! The production of electricity via nuclear means is irrational! (**0095-1** [Craig, Anne])

Comment: From the mining of the uranium to the transport of the materials to the huge amounts of water used in the energy production, to the production of the dangerous waste that has no safe storage, nuclear energy is unsafe, unhealthy and dangerous to life. (**0095-2** [Craig, Anne])

Comment: In conclusion, let me state that nuclear power is expensive and dangerous... (**0104-4** [Bliss, Rachel])

Comment: It's really simple: nuclear energy is dangerous, non-renewable and extremely not cost efficient! You already know this . . . if you don*t you have your heads in the sand! From the mining of the uranium which devastates Native American land and causes lung disease in the workers, to the huge amount of water, an increasingly precious resource, needed to cool the reactors, to the routine radioactive releases, to the extremely toxic waste whose storage has no solution, the production of electricity by nuclear means is not only an environmental disaster, but is morally bankrupt. I could write about the increases of cancer near nuclear plants, the degraded water and rivers, the potential of damage to nuclear plants by earthquakes, and more, but you should know all this by now. NO NEW NUCLELAR PLANTS! SHUT THE EXISTING ONES DOWN! (**0105-3** [Craig, Anne])

Comment: No more nukes, please! There are truly green solutions. There are other options. I truly believe that going forward into our future with nuclear power is horribly wrong. (**0107-4** [Acs, Deborah])

Comment: I am 100 percent opposed to any new nuclear construction anywhere in the world. (**0110-1** [Genetti, Phyllis])

Comment: There is glaring evidence against the use of nuclear facilities as a use for power and too many incidents that you are aware of that I could name. NO TO NUCLEAR ANYTHING. (**0110-3** [Genetti, Phyllis])

Comment: Nuclear power plants are dangerous to the environment and the public... (**0112-1** [Andrews, Josephine] [Anonymous] [Beattie, Kathryn E.] [Boever, Virginia] [Boyle, Ella] [Brogan Prindle, Cathleen] [Davis, John] [Flores, S.] [Hamahan, Clare] [Keil, A. Eugene] [Leverette, Will] [Peterson, Harry] [Peterson, Martha J.] [Rittenberg, David] [Rustin, K.])

Comment: Nuclear Energy is deadly, unsafe, dirty and really non-renewable. It poses potential hazards to the entire environment as well as to surrounding areas. (**0113-3** [Rose, Katherine])

Comment: The existing nuclear facilities in the USA are all in need of serious maintenance work or should be shut down. (**0114-2** [Lovinsohn, Ruth])

Comment: Nuclear power is dangerous & toxic. (**0114-4** [Lovinsohn, Ruth])

Response: *These comments express general opposition to nuclear power and do not provide any specific information relating to the environmental effects of the proposed action. No changes were made to the EIS as a result of these comments.*

Comment: A nuclear power plant can be dangerous. Why have so many countries now decided to shut down nuclear power plants over time, for sure not build new ones? (**0001-2** [Stoll, Irene])

Comment: If (when) something unfortunate happens the results can be so disastrous, as has been shown at both Chernobyl and Fukushima, that there really is no way to stop the spread of contamination from a leak, no way to protect the surrounding area from ruination and no way to clean up the resulting mess. (**0002-2** [Smy, Gayle and Allison])

Comment: I am not at all convinced that nuclear power is safe or that Duke Power knows how to manage such plants. The recent problems with the Fukushima Plant in Japan have highlighted this issue and I do not believe that any more plants should be built. (**0003-2** [Arnold, Debbie])

Comment: Nuclear power plants are dangerous to the environment and the public. After the Fukushima disaster, we learned just how devastating nuclear radiation is to the land, water, people and animals. We still don't know the long term affects of Fukushima's nuclear meltdown. After the Chernobyl fallout, victims are still suffering from debilitating diseases 124 miles from the Chernobyl nuclear plant. (**0004-1** [Cunningham, Kristine])

Comment: Have we not had ample proof in this last calendar year that nuclear power is a thing of the past? Did the ongoing disaster at Fukushima Daichi have no impact on our civic mind? (**0007-1** [Tinnaro, Heather])

Comment: After the recent Fukushima disaster, we see proof again that it can happen. Unanticipated natural disasters, human error and failings, terrorist attacks -- that have not been mentioned -- systems malfunction can happen despite all the reassurances the nuclear industry and the NRC makes. Toxic radiation knows no boundaries. Chernobyl's radiation reached California in ten days. Thousands died and continue dying today. The Three Mile Island came very close to being worse than Chernobyl. Fukushima's radiation fallout easily reached California and even our east coast and beyond. (**0012-19-4** [Howarth, Irma])

Comment: Each time there's an accident or a mishap or whatever you want to call it, leak, you hear that lessons learned -- the nuclear industry has learned a lesson, now they're going to do better. The lesson that should have been learned from some of these things, especially the one in Japan, is we ought not to be continuing with nuclear power if we can't handle the waste and having all these problems. (**0012-3-3** [Thomas, Ruth])

Comment: Whereas Three Mile Island, Chernobyl, and Fukushima have taught everyone on our planet that radiation has no boundaries. (**0013-11-2** [Smith, Coleman])

Comment: I wish to add that the warnings of the Japanese disaster is making -- the warning of the Japanese disaster is making many nations rethink their policies. And, therefore, I'm seconding the comments of the pathologist who spoke before me. We now know that people living in the vicinity of Japan's Fukushima Daiichi facility have radioactive urine. (**0013-16-2** [Zdenek, Dr. Joe])

Comment: ...in general nuclear plants can be catastrophically dangerous, as witnessed by the recent Fukushima tragedy in Japan. (**0019-2** [Doebber, Tom])

Comment: ...in general nuclear plants can be catastrophically dangerous, as witnessed by the recent Fukushima tragedy in Japan. (**0020-2** [Klein, Art and Michelle])

Comment: In general nuclear plants can be catastrophically dangerous, as witnessed by the recent Fukushima tragedy in Japan. (**0026-1** [Doebber, Ian] [Doebber, Rachel])

Comment: I thought that [Fukashima] taught us how dangerous this form of energy can be. I know the argument is that all precautions are taken, but that can never be completely foreseen and the ramifications are too great. I especially don't like being within 60 miles of a possible disaster. There are numerous reasons these plants are not the best form of producing energy, but the Japan disaster experience should be enough to realize we would be foolish to continue to build new nuclear power plants. (**0027-3** [Nord, Felice])

Comment: Nuclear power is not safe. I'm sure I do not need to lay out the many issues that Japan is dealing with and will continue to be encumbered with for decades to come. (**0030-3** [Swing, Carol])

Comment: How many Chernobyls and Fukushimas do we need to make us fear such a facility so close to home? Even with an extremely limited danger of a similar catastrophy here, there is always the possibility of a terrorist attack and human error can and does happen all the time. (**0033-2** [Gardner, Janet])

Comment: Nuclear power is not safe. (**0037-1** [Collins, Richard])

Comment: The possibility of a Fukushima or Chernobyl-type disaster is terrifying. (**0039-2** [Whiteside, Cassie])

Comment: The possibility of a Fukushima or Chernobyl-type disaster is terrifying. (**0043-2** [Reeser, Rachel])

Comment: With the examples of Three Mile Island, Chernobyl, and Fukushima, it is CLEAR that nuclear power is NOT SAFE. (**0051-2** [Oehler, Susan])

Comment: Three Mile Island, Chernobyl, and Fukushima are glaring examples of the dangers. (**0061-2** [Holt, Cathy])

Comment: We already live in the shadow of two nuclear power plants, Mcguire and Catawba, so two more will double the risk of an accident that would affect us. We strongly object to the proliferation of nuclear facilities in general, and particularly, as you might imagine, near us. People are fallible, and so are the designers and operators of these facilities. They are disasters waiting to happen. An unexpected rupture or a faulty meter, operator error or a simple failure of equipment could set off a dangerous chain of events that we are not equipped to deal with. (**0063-4** [da Silva, Arjuna])

Comment: I suspect that potentially dangerous, unforeseen events happen on a regular basis that are not reported to the general population. (**0063-5** [da Silva, Arjuna])

Comment: Need we mention the horrors of Three Mile Island, Chernobyl and Fukushima? The Fukushima disaster alone should be reason enough to put a moratorium on more new nuclear facilities, and encourage the development of viable alternatives. We already live in the shadow of two nuclear power plants, Mcguire and Catawba, so two more will double the risk of an accident that would affect us. We strongly object to the proliferation of nuclear facilities in general, and particularly, as you might imagine, near us. People are fallible, and so are the designers and operators of these facilities. They are disasters waiting to happen. An unexpected rupture or a faulty meter, operator error or a simple failure of equipment could set off a dangerous chain of events that we are not equipped to deal with. (**0076-2** [Anonymous])

Comment: With your blinders on, you can argue that Fukushima was on the coast, hit by a tsunami, in an earthquake zone. The Frontline story led with concern about the Indian Point nuclear reactor near New York City, which could very easily, in case of an earthquake, be similar to Fukushima. You can argue that the proposed Lee Nuclear Power Plant doesn't fit into that scenario. You can argue that the General Electric reactor was poorly designed. How can you KNOW for sure that anyone else's nuclear reactor is safe? The fact is that EVERY nuclear power plant in this country and around the world is potentially devastating. Just think about the

North Anna Nuclear Power Plant in Virginia, hit by an unimagined earthquake in 2011. You can argue that this is a bullet dodged. But how can we believe that ANY of the nuclear plants are safe? (**0089-2** [Thomas, Ellen])

Comment: I would like to conclude with my final observation. The power plant in my last community was built in a rural, impoverished area, where it offered jobs, built a new school and community center. That poor community became dependent on its financial support, overlooking the increasing reports that were often initially covered up in regard to: the crumbling cooling tower; cracks in the steam dryer; ongoing valve leaks, and radioactive ground water. Sadly, people in this position cannot see the harm when they are told by their employer over and over and over.. for forty years, that things are safe. It is not until a Three Mile Island, a Chernobyl or a Fukushima happens that those who are dependent on nuclear energy start to question their belief system. It is time we stop harming our health and our planet. (**0099-3** [Greenberg, Lori])

Comment: The operators of the Fukushima Nuclear Plant were assured that plant was safe from storms and earthquakes, but no one ever thought about a tsunami that would send waves into the plant grounds above protective walls that were only a third as high as those that flooded the plant causing catastrophes so overwhelming that since then Germany has said it will eventually discontinue use of nuclear power, and PBS's Frontline predicts that Japan itself will close down all 54 of its plants. (**0104-7** [Bliss, Rachel])

Comment: Despite the rhetoric, nuclear energy is not "green" or "clean." It is a weapon that has the potential to harm and kill millions of people. (**0111-2** [Knudten, Cori])

Comment: Current nuclear power technology is not safe by any stretch of the imagination. (**0116-2** [Schmitt, Daniel])

Comment: Nuclear power is said to be safe, but we all remember Three Mile Island, Chernobyl, and Fukushima. If it were safe, then the insurance industry would offer sufficient insurance to cover the possible damages, such as the $235billion (and rising) damages from Fukushima's four melted reactors. Even cutting the damages in half, to reflect two reactors instead of four, there is $177.5 billion to be covered, but the insurance industry refuses to cover more than $11.6 billion for all nuclear plants in the U.S., which is less than 10% of the potential damages from just this pair of proposed reactors alone. Who would cover the rest, if Fukushima happened here? You and me via another public bailout. This is no time for any large corporation to be proposing another bailout. The public will not stand for it. Without insurance, nuclear power is unsafe. So, if safety is the issue, these plants should not be built. (**0117-2** [Crissey, Brian])

Comment: It is your job to ensure that no nuclear project is approved unless it is shown to be safe. There is no nuclear project that can be proven safe. Its very existence poses a risk of leaks, meltdowns, the contamination of carcinogens to the surrounding community.... (**0121-1** [Wallace, Kristine])

Comment: Nuclear power is above all DANGEROUS-to our basic human biology as well as for the concomitant diseases that have been proven by science. Its properties are carried by wind and water-there is no safe level of radiation. The so-called 10mile rule has not held true around the world. Most recently, the Fukushima fallout reached Tokyo; and Asheville, NC is three times closer to the proposed Gaffney nuclear plant.
(**0133-2** [Christopher, Lucy D.])

Response: *These comments provide general information in opposition to nuclear power. Some comments cite the Fukushima, Chernobyl, and Three Mile Island accidents as evidence that nuclear power is unsafe. They do not provide any specific information related to the environmental effects of the proposed Lee Nuclear Station. Issues related to safety are beyond the scope of the environmental review and will be evaluated in the NRC staff's FSER for the proposed Lee Nuclear Station, which is tentatively scheduled for publication in 2015.*

The following summarizes the major accidents cited by some of the commenters.
On March 28, 1979, the Three Mile Island accident occurred in Pennsylvania as a result of equipment malfunctions, design-related problems, and worker errors. The accident melted almost half the reactor core of Unit 2 and released contaminated water and radioactive material into the containment building. A very small amount of radioactive material reached the environment. It remains the most serious accident in U.S. commercial nuclear power plant operating history although no plant workers or members of the nearby community were injured or killed. A long-term follow-up study by the University of Pittsburgh that evaluated local, county, and State population data from 1979 through 1998 concluded that there is not an increase in overall cancer deaths among the people living within a 5-mile radius of Three Mile Island at the time of the accident (NRC 2012c). This accident brought about sweeping changes for nuclear power plants and heightened oversight by the NRC. NRC Fact Sheets about the Three Mile Island accident are available at: http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html.

On April 26, 1986, an accident destroyed Unit 4 of the nuclear power station at Chernobyl, Ukraine, in the former USSR. The series of events that led to this accident could not occur at U.S. commercial power reactors because U.S. reactors have different plant designs, robust containment structures, and operational controls to protect them against the combination of lapses that led to the accident at Chernobyl. Its operators ran an experiment that led to a sudden surge of power, destroying the reactor core and releasing massive amounts of radioactive material into the environment. About 30 emergency responders died in the first 4 *months after the accident. The health of the evacuated population and populations in contaminated areas of Belarus, the Russian Federation, and Ukraine has been monitored since 1986. Monitoring efforts to date indicate that a lack of prompt countermeasures resulted in increased risk of thyroid cancer to members of the public, most notably among people who were children or young adults at the time of the accident. No other health effects are attributed to the radiological exposure in the general population. Chernobyl's design, which differed significantly from reactors operating in the United States, made it vulnerable to such a severe accident. The NRC Fact Sheet about the Chernobyl accident is available at: http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/chernobyl-bg.html.*

In a significant difference from the Chernobyl accident, Japanese authorities enacted prompt countermeasures based on international guidance to minimize the radiological health impacts from the release of radioactive material from the Fukushima Dai-ichi site. This included sheltering-in-place, evacuation, radiation monitoring and surveys, and interdiction of contaminated food-stuff and drinking water. Not long after the emergency began, the NRC established a task force of senior NRC experts to determine lessons learned from the accident and to initiate a review of NRC regulations to determine if additional measures should be taken immediately to ensure the safety of U.S. nuclear power plants. The task force issued its report with recommendations on July 12, 2011, concluding that continued U.S. nuclear plant operation and NRC licensing activities presented no imminent risk. The task force also concluded that enhancements to safety and emergency preparedness are warranted and made several general recommendations for Commission consideration. The NRC staff (NRC 2012d) issued SECY 12-0025, detailing the proposed Orders and required actions in response to lesson learned from Japan's March 11, 2011, earthquake and tsunami. For new reactors and COLs (e.g., Lee Nuclear Station), the staff will ensure that the Commission-approved Fukushima actions are addressed prior to licensing.

On March 9, 2012, the Commission directed its staff to issue immediately effective Orders to U.S. commercial nuclear reactor licensees to begin implementation of several recommendations for enhancing safety at U.S. reactors based on lessons learned from the accident at Japan's Fukushima Dai-ichi nuclear power plant (see NRC News Release 12-023 at http://pbadupws.nrc.gov/docs/ML1206/ML120690627.pdf). Two of the Orders apply to every U.S. commercial nuclear power plant, including those under construction and the recently licensed new Vogtle and V.C. Summer reactors. The first Order requires plants to better protect safety equipment installed after the September 11, 2001 terrorist attacks and to obtain sufficient equipment to support all reactors at a given site simultaneously. The second Order requires plants to install enhanced equipment for monitoring water levels in each plant's spent fuel pool. The third Order applies only to U.S. boiling water reactors that have "Mark I" or "Mark II" containment structures. These reactors must improve venting systems (or, for the Mark II plants, install new systems) that help prevent or mitigate core damage in the event of a serious accident. Plants have until December 31, 2016, to complete modifications and requirements of *all three Orders. The NRC also issued a detailed information request to every operating U.S. commercial nuclear power plant; certain parts of the information request apply to reactors currently under construction or recently licensed.*

The following NRC websites have additional information on the Fukushima accident and the NRC's response: http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/fs-japan-events.html and http://www.nrc.gov/reactors/operating/ops-experience/japan-dashboard.html.

Section 5.11, Environmental Impacts of Postulated Accidents, has been revised to include the recent Commission Orders related to the lessons learned from the accident at Japan's Fukushima Dai-ichi nuclear power plant. No other changes were made to the EIS as a result of these comments.

E.2.30 Comments Concerning Issues Outside Scope - Emergency Preparedness

Comment: The NRC has not taken into consideration the safety mile radium beyond 50 miles. This EIS must be based on facts, not theory. I have -- we have the facts and lessons learned from Chernobyl and Fukushima. Hot spots of radiation have been found far from the Fukushima area, in fact as far as 180 miles of the reactor site. This follows the same trend as Chernobyl. The initial 30-kilometer evacuation zone has become known as the dead zone. But evacuations and other protective measures occurred as many locations as far as 200 miles away. (**0013-7-1** [Sorensen, Laura])

Comment: The NRC chief reported to Sen. Barbara Boxer in a recent report that 26 million potassium iodide tablets have been distributed to States. US population is 310.5 million. (**0018-3** [Vestal, Majorie])

Comment: Fukushima proves that assigning 10-mile or 50-mile evacuation zones is totally inadequate, as no one can predict how far or in what direction a plume might travel. (**0119-11** [Thomas, Ruth])

Comment: The problem of operating a nuclear station means continually being prepared for a nuclear accident, including identifying evacuations centers, keeping residents over a large area informed and trained for a nuclear emergency. (**0119-16** [Thomas, Ruth])

Response: *These comments relate to the adequacy of emergency plans, which is a safety issue outside the scope of the NRC staff's environmental review. As part of its safety review for the proposed Lee Nuclear Station, the NRC staff will determine, after consultation with the U.S. Department of Homeland Security and the Federal Emergency Management Agency, whether the emergency plans submitted by Duke are acceptable. No changes were made to the EIS in response to these comments.*

Regarding potassium iodide (KI), the Commission issued a Final Rule on KI in the Federal Register on January 19, 2001 (66 FR 5427). The NRC will not require use of KI by the general public because the NRC believes that current emergency planning and protective measures—evacuation and sheltering—are adequate and protective of public health and safety. However, the NRC recognizes the supplemental value of KI and the prerogative of the States to decide the appropriateness of distributing KI to its citizens. At this time, the NRC has made KI available to States that wish to include thyroid prophylaxis in their range of public protective actions in the event of a serious accident at a nuclear power plant.

E.2.31 Comments Concerning Issues Outside Scope - Miscellaneous

Comment: Duke and Progress said their proposed merger was the only way to build more nuclear but the Federal Government has refused the request twice in opposition to such a large monopoly. (**0048-7** [Skeele, Michele and Skip])

Response: *This comment expresses concern regarding the Duke Energy and Progress Energy merger, which was completed on July 3, 2012. The NRC is not involved in establishing anti-trust policy with regard to their licensees. Rather, it regulates the nuclear industry to protect the public health and safety and common defense and security within existing policy. No change was made to the EIS as a result of this comment.*

Comment: But "Mr. Duke," plans to build two reactors without sufficient insurance and without a political mandate for a bailout. If a Fukushima disaster were to strike this site, many persons would find their properties unreasonably seized. So building these reactors is unconstitutional. (**0117-7** [Crissey, Brian])

Comment: We are told that nuclear power is safe, but without sufficient insurance, it is much more dangerous than energy efficiency and renewables. (**0117-9** [Crissey, Brian])

Comment: The problem that one of the subsidies, the Price-Anderson Act, could in no way recompense victims of a nuclear accident. The many of billions it would cost for evacuation and relocation of families, businesses, hospitals, and schools, and for cleanup (if possible), would come once again from the taxpayers. (**0119-10** [Thomas, Ruth])

Comment: Who Pays for Nuclear Accidents?

The Price-Anderson Act protects the nuclear industry from liability claims arising from nuclear incidents. The Act establishes a no fault insurance-type system in which the first approximately $12.6 billion is industry-funded; claims above the $12.6 billion would be covered by a Congressional mandate to retroactively increase nuclear utility liability or would be covered by the federal government.

In a Fourth Circuit Court decision challenging the Price-Anderson Nuclear Industries Indemnity Act, plaintiffs raised the issue of due process. In 1978 the Supreme Court overturned the decision of the lower court. Justice John Paul Stevens concurred in the judgment but in a separate opinion said:

With some difficulty I can accept the proposition that federal subject-matter jurisdiction under 28 U.S.C. 1331 (1976 ed.) exists here, at least with respect to the suit against the Nuclear Regulatory Commission, the agency responsible for the administration of the Price-Anderson Act. The claim under federal law is to be found in the allegation that the Act, if enforced, will deprive the appellees of certain property rights, in violation of the Due Process Clause of the Fifth Amendment. One of those property rights, and perhaps the sole cognizable one, is a state-created right to recover full compensation for tort injuries. The Act impinges on that right by limiting recovery in major accidents. But there never has been such an accident, and it is sheer speculation that one will ever occur. For this reason I think there is no present justiciable controversy, and that the appellees were without standing to initiate this litigation.

Now, there have been such accidents. The Supreme Court decision occurred the year before the partial meltdown at Three Mile Island and the release of the eponymous "China Syndrome." Tokyo Electric Power Company's government bailout may reach $137 billion for the Fukushima nuclear disaster.

Justice Stevens continued:

The Court's opinion will serve the national interest in removing doubts concerning the constitutionality of the Price-Anderson Act. I cannot, therefore, criticize the statesmanship of the Court's decision to provide the country with an advisory opinion on an important subject. Nevertheless, my view of the proper function of this Court, or of any other federal court, in the structure of our Government is more limited. We are not statesmen; we are judges. When it is necessary to resolve a constitutional issue in the adjudication of an actual case or controversy, it is our duty to do so. But whenever we are persuaded by reasons of expediency to engage in the business of giving legal advice, we chip away a part of the foundation of our independence and our strength. (**0130-11** [Zeller, Lou])

Response: *These comments concern insurance for nuclear power plants and the issue of liability in the event of a severe accident. The NRC requires financial assurance for decommissioning for all applicants, which also must carry nuclear accident insurance under the Price-Anderson Act, which became law on September 2, 1957. The Price-Anderson Act was designed to ensure that adequate funds would be available to satisfy liability claims of members of the public for personal injury and property damage in the event of a catastrophic nuclear accident. The legislation helped encourage private investment in commercial nuclear power by placing a cap, or ceiling, on the total amount of liability each holder of a nuclear power plant* *license faced in the event of a catastrophic accident. Over the years, the "limit of liability" for a catastrophic nuclear accident has increased the insurance pool to over $10 billion. Under existing policy, utilities that operate nuclear power plants pay a premium each year for $300 million in private insurance for offsite liability coverage for each reactor unit. This primary insurance is supplemented by a second policy. Because virtually all property and liability insurance policies issued in the United States exclude nuclear accidents, claims resulting from nuclear accidents are covered under the Price-Anderson Act, which includes any accident (including those that come about because of theft or sabotage) in the course of transporting nuclear fuel to a reactor site, in the storage of nuclear fuel or waste at a site, in the operation of a reactor (including the discharge of radioactive effluent), or in the course of transporting irradiated nuclear fuel and nuclear waste from the reactor. The Energy Policy Act of 2005 extended the Price-Anderson Act to December 31, 2025. These comments do not provide information relevant to environmental review; therefore, no changes were made to the EIS as a result of these comments.*

Comment: If the proposed power plant is truly safe, then it should be built in Downtown Charlotte, where the waste heat of cooling the reactors can be put to good use, heating homes and businesses in the winter and cooling them in summer with evaporative chillers. Unfortunately, the wide radius of the emergency planning zones outlined by the NRC makes any practical use of the waste heat impossible, as thermal losses preclude transmitting steam across a distance of so many miles. (**0129-3** [Gamble, Dan])

Response: *The Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.), as amended, and the Energy Reorganization Act of 1974, places on the NRC the responsibility for the licensing and regulation of private nuclear facilities from the standpoint of public health and safety. Part 100, "Reactor Site Criteria," of Title 10 of the Code of Federal Regulations (10 CFR Part 100) requires that the population density; use of the site environs, including proximity to man-made hazards; and the physical characteristics of the site, including seismology, meteorology, geology, and hydrology be taken into account in determining the acceptability of a site for a nuclear power reactor. Appendix A to 10 CFR Part 50 establishes minimum requirements for the principal design criteria for water-cooled nuclear power plants, and Appendix S to Part 50 provides engineering criteria for nuclear power plants. A number of these criteria are directly related to site characteristics as well as to events and conditions outside the nuclear power unit.*

Site selection involves consideration of public health and safety, engineering and design, economics, institutional requirements, environmental impacts, and other factors. The potential impacts of the construction and operation of nuclear power stations on the physical and biological environment and on social, cultural, and economic features (including environmental justice) are usually similar to the potential impacts of any major industrial facility, but nuclear power stations are unique in the degree to which potential impacts of the environment on their safety must be considered. Siting considerations are outside the scope of the environmental *review and are addressed in the NRC staff's safety review. The NRC staff's FSER is tentatively scheduled to be issued in 2015. No change was made to the EIS as a result of this comment.*

Comment: Regulations limiting carcinogens in other federal agencies are set at much more protective levels. Equal protection under the law must mean that equal standards for protecting public health. The National Research Council published the following analysis:

Rather than gear criteria to an analytic technique, the agency defined its standards in terms of risk. It proposed that any assay approved for controlling a carcinogenic drug must be capable of measuring residues that present more than an insignificant risk of cancer, and specified a 10-6 lifetime risk of cancer as a quantitative criterion of insignificance. (**0130-9** [Zeller, Lou])

Response: *The NRC's mission is to protect the public health and safety and the environment from the effects of radiation from nuclear reactors, materials, and waste facilities. The NRC's regulatory limits for radiological protection are set to protect workers and the public from the harmful health effects of radiation on humans (i.e., cancer and other biological impacts). The limits are based on the recommendations of standards-setting organizations (e.g,. the NCRP and the ICRP). Radiation standards reflect extensive scientific study by national and international organizations. The NRC actively participates and monitors the work of other organizations to keep current on the latest trends in radiation protection. If the NRC determines that there is a need to revise its radiation protection regulations, it will initiate a rulemaking. The public his given the opportunity to participate in the rulemaking process that established the regulations that govern its review process. More information on NRC's roles and responsibilities is available on the NRC's website at http://www.nrc.gov/what-we-do.html. No change was made to the EIS as a result of this comment.*

E.2.32 Comments Concerning Issues Outside Scope - NRC Oversight

Comment: Last, but no means least, we have lost any confidence that we may have had in the Nuclear Regulatory Commission. I cite just a few of the reasons why: A) After the Browns Ferry fire, new regulations were put into play. As of today, 30 years later, 47 nuclear plants are not in compliance with these regs, including Browns Ferry. B) Indian Point, New York is built on an earthquake fault with 17 million people within 50 miles of this plant. C) The North Anna Plant was determined to be seismically under-designed. The NRC asked for upgrades but did not require them. The owners did not comply. (**0012-10-5** [Connolly, Mary Ellen])

Comment: I suspect that potentially dangerous, unforeseen events happen on a regular basis that are not reported to the general population. (**0076-3** [Anonymous])

Comment: A number of plants are continuing to operate beyond their scheduled decommission date, a fact that does not inspire confidence. It is obvious to anyone with a functioning brain that these facilities are too dangerous to be allowed to continue operating. (**0076-5** [Anonymous])

Comment: How many more disasters must there be before the NRC recognizes that it cannnot effectively regulate the nuclear industry? Mr. Jaczko, NRC Director, admitted that the NRC does not have the power to require the private nuclear industry to maintain safe standards--it only has the power to "request" that it do so. And abundant evidence exists that many stations do not comply with safety standards. The NRC is supposed to protect the American public. (**0111-4** [Knudten, Cori])

Comment: The problem of needing a new oversight agency which is not comprised of members of the nuclear industry or other vested interests. (**0119-14** [Thomas, Ruth])

Response: *These comments, in general, express criticism of NRC's oversight of the nuclear industry. The NRC takes seriously its statutory responsibilities to protect the health and safety of the public and the environment in regulating the U.S. nuclear power industry. More information on NRC's roles and responsibilities is available on the NRC's website at http://www.nrc.gov/about-NRC.html. While NRC oversight of the industry and operational safety are outside the scope of the environmental review, the following are examples of how the NRC addresses operational safety issues.*

- *NRC maintains resident inspectors at each reactor site. These inspectors monitor the day-to-day operations of the plant and perform inspections to ensure compliance with NRC requirements.*

- *The NRC has an operational experience program that ensures that safety issues found at one plant are properly addressed at the others, as appropriate.*

- *The design of any new reactors or storage facility will have already benefited from lessons learned at existing reactors and incorporate new safety features that would be impracticable to backfit onto existing plants. The NRC will only issue a license or permit if it can conclude that there is reasonable assurance (1) that the activities authorized by the license or permit can be conducted without endangering the health and safety of the public and (2) that such activities will be conducted in compliance with the rules and regulations of the Commission.*

- *To ensure objectivity and independence in its regulatory activities, the NRC and the Office of Government Ethics have stringent rules and procedures to ensure that employees of, and advisors to, the NRC are free of conflicts of interests and the appearance of conflicts of interest.*

The comments did not provide information relating to the environmental effects of the proposed Lee Nuclear Station and are considered outside of the scope of the environmental review. No changes were made to the EIS as a result of these comments.

Comment: $ SHOULD BE SPENT TO REDUCE RISKS at existing plants, Better handle EXISTING TOXIC WASTE CLEAN UP and SHUT DOWN or MAINTENANCE EFFORTS. (**0088-2** [Lovinsohn, Ruth])

Comment: $ should be spent to clean up / maintain & shut down aging plants & prevent more damage from radioactive waste. (**0114-13** [Lovinsohn, Ruth])

Response: *These comments express opposition to the proposed action and assert that instead money should be spent maintaining the current fleet of nuclear reactors and their nuclear waste, as well as decommissioning existing nuclear reactors. These comments provide no information related to the environmental effects of the proposed Lee Nuclear Station, and no changes were made to the EIS.*

E.2.33 Comments Concerning Issues Outside Scope - Safety

Comment: [Building the W.S. Lee Nuclear Plant will:] Use the AP1000 reactor from fast tracked technology that hasn't been built yet, makes it more dangerous to the public due to unknown variables. Rep. Ed Markey's report from scientist who have investigated the reactor shield and stated it could "shatter like a glass cup' if impacted by an earthquake or other natural or man-made impact. In addition,The independent oversight group Fairewinds Associated listed concerns that the AP1000 design could release radiation directly into the air due to containment issues. Containment issues have been reported in 5 nuclear plants in the United States. (**0004-9** [Cunningham, Kristine])

Comment: But what I really want to talk about today is the reactor which Duke Energy plans to build, and this is an AP-1000 Westinghouse reactor. The reactor that Westinghouse has designed and that Duke has selected is supposedly an inherently safe design. In order to make the reactor cheaper to build and simplify, they eliminated a lot of pumps and piping in order to bring this design to fruition. This is the containment building here that I have drawn, it's a dome-shaped structure, and this would be the power plant, the reactor vessel inside. There is also at the top of this reactor a water tank of about 800,000 gallons which weighs about 3,334 tons, suspended on top of this reactor. Now, this reactor is a modular design, it's put together in pieces, and one of the Nuclear Regulatory Commission's own people reviewing this design came to the conclusion that because of the modular construction -- again, another cost-saving measure instead of casting it in one piece -- it would shatter like glass, according to Dr. John Mott, because of the modular construction. In addition to that, I mentioned the water tank up here which is supposed to provide gravity flow in case of loss of power, which is one of the principal things that destroyed the Fukushima Nuclear Power Plant. So instead of having to pump water up from below with electric power provided by generators, you have a gravity-fed system. Well, that sounds good, but 3,300 tons of water balanced on top of a structure which itself, for example, the reactor vessel itself weighs about 400 tons compared to that over 3,000 tons of water balanced at the top of this reactor, you have an unstable situation because the reactor itself is not only modular constructed which could shatter like glass, you also have the heavy weight at the top. This is not inherently safe, this is inherently dangerous. Another so-called safety feature, I've drawn a double shell here, and that is to, according to the design, allow air to circulate freely between the steel shell and the concrete shell on the outside. You might could see that this air circulates out and then leaves the top of the reactor. This is an annular ring, it's called, which basically surrounds the whole structure. There's a gap in here which is a departure from earlier designs which had the steel and the concrete touching. What's the problem? This so-called safety feature leads to new fundamental weaknesses which have not been addressed in the licensing and the approval of AP1000, and that is this: this steel shell inside is subject to corrosion. Dr. Rudolph Houser has pointed out that this is not a good system because paints and other corrosion protection features are only guaranteed for a period of about ten years, according to the manufacturer. Then it's up to who applies the paint to meet the regulations. So he recommended against the use of this entire construction method. What can happen here if you have an event within the reactor where there is an escape of radioactive steam filling up the building and you have a gap anywhere in this shell, it would join the normal circulation of air like a syphon effect, sucking air from inside the radioactive gases inside that building through that annular gap between the steel and the concrete, exiting out to the atmosphere. A nuclear power vessel, a containment structure is supposed to do that, it's supposed to contain it. So this is the design which Duke Energy has proposed, Westinghouse has designed, the Nuclear Regulatory Commission has proposed and which business leaders in South Carolina are apparently inviting in without question. This is the reactor, this is the danger which you are inviting in to Cherokee County. (**0012-11-2** [Zeller, Lou])

Comment: About a decade ago engineers warned that the levees would break under a Category 5 hurricane around New Orleans. No one listened and it happened. Ten years ago we were warned that terrorists may strike Twin Towers in New York. Nobody listened and it happened. There is Fukushima. You know, they built walls that would prevent waves coming in and contaminating the plant. The waves came in from a tsunami at three times the height of the walls, and you see what happened there. Now, let's go to the present time. We've had an engineer with the Nuclear Regulatory Commission who has said that the reactor could shatter like a glass cup if it's not changed. We've had Representative Markey of the Natural Resources Committee who has said the same thing. We have had the chair of the NRC say that this reactor has not -- does not stand up to his scrutiny. He changed his mind shortly thereafter when all the other commissioner voted against his suggestion. Thirteen groups at least -- probably much more -- have said that this reactor that is proposed is not up to the safety that is required. Back in 1913 Union County, just one county below Cherokee, had an earthquake, a 5.5 on the Richter scale. This -- there is no reason that that can't happen again. Too often we humans have looked at probability and written off one in a hundred, one in a thousand, even one in a million as not worth preparing for after a cost benefit analysis. Tell this to more than the 100,000 residents of Fukushima who are now unable to return to their homes. Tell this to the people near Fort Calhoun Nuclear Plant in Nebraska that came within inches of nuclear calamity when the Missouri River flooded out of its banks for months. Many of us who are parents and grandparents say the chances of failure of this newly-designed AP1000 are just too high. (**0013-13-1** [Bliss, Rachel])

Comment: ....we do not trust the safety of this plant's untested reactor with Gaffney being just one of the nuclear sites where this reactor will be used. (**0013-13-6** [Bliss, Rachel])

Comment: Duke is proposing two new reactors designed by Westinghouse, the new AP1000 design. The U.S. Nuclear Regulatory Commission recently gave a stamp of approval to this new design against the objections of a group of independent nuclear analysts, engineers, and concerned citizens known as the AP1000 Oversight Group. This group, led by concerned citizens of the Carolinas; including NC WARN nuclear information and resource service; and many other local and regional organizations, brought forward a key concern about the design, which the Draft Environmental Impact Statement for the proposed William States Lee fails to adequately address. The one-inch thick steel containment of the AP1000 is encircled by an open-to-the-air shield building that will be vulnerable to moisture and water vapor. Over time it is possible that such a containment building could corrode, like 17 others examples of corrosion brought by the oversight group to the NRC's attention in the existing fleet of reactors. It is possible that a small hole, the diameter of a pencil, could be undetected in the wall of the relatively thin containment. If a core accident were to happen after a hole was formed, there would be a release of concentrated radioactivity to the environment. Our concern is that this release could be large and spread rapidly to the surrounding area, damaging people and our environment due to the new Westinghouse design itself. We in the oversight group find that some of the so-called passively safe features are, in fact, actively dangerous. Since Westinghouse did not design a shield building as containment, but rather as a gamma shield and an updraft cooling for the containment, it would not impede the release of radioactivity. Instead, the cooling tower updraft of the shield building would act as a chimney to suck more radioactivity out of the containment in a shorter period of time than would occur otherwise. This early failure to contain radioactivity could greatly necessitate an early emergency response and evacuation, which Westinghouse has claimed is not necessary because of the so-called passive safety features. We are also concerned that this actively dangerous design could spread more radioactivity across a wider area since the shield building updraft might result in the plume obtaining a higher altitude. This would result in a radioactive deposit on more land, on a larger watershed area, on more urban populations, affecting more species. Just where? Well, according to the vagaries of wind and rain. The Draft Environmental Impact Statement for Duke's proposed reactors fails to adequately address these concerns. (**0013-24-1** [Hearne, Ray])

Comment: Representative Markey, who's on the Natural Resource Committee, stands behind an NRC staff report from Dr. John Maw, who warned that this actual AP reactor they're talking about, if it's subjected to any kind of force it's going to break like a glass cup. So here's the NRC getting this information, questioning Westinghouse about it one month, and the next month they're on a fast track to approve the reactor. That to me is irresponsible and it's confusing for someone who's trying to follow the facts because one minute -- I mean, it's really hard to trust what the NRC is doing. Because they haven't asked for any design changes or seen any, it seems like this new reactor we're guinea pigs to it. (**0013-7-4** [Sorensen, Laura])

Comment: AP1000 Westinghouse Reactor: Rep Ed Markey's statement: "Instead of doing all they should to protect nuclear reactors against seismically-induced ground acceleration, these Commissioners (NRC) voted to approve the acceleration of reactor construction." "They have fast-tracked construction of a reactor whose shield building could 'shatter like a glass cup' if impacted by an earthquake or other natural or man-made impact". This is a new design, never been built, that is proposed for 14 new reactors in the Southeast. (**0017-10** [Morgan, Tom and Barbara])

Comment: The reactor design to be used is a first time, never been built, thus untested in reality. As US Rep. Markey stated: "reactor shield building could shatter like a glass cup if impacted by an earthquake or other natural or man-made impact". (**0019-6** [Doebber, Tom], **0020-6** [Klein, Art and Michelle], **0026-5** [Doebber, Ian] [Doebber, Rachel])

Comment: [Before acting on this proposal, adequate AND PUBLIC review should include:] Critical review to ensure that the design has adequate fail-safe elements to avoid meltdown and release of radiation as happened recently in Japan... (**0021-7** [Rinsler, MD, Steve])

Comment: The use of novel and untested designs should be disallowed... (**0021-8** [Rinsler, MD, Steve])

Comment: The reactor that is proposed for this new site is untested and, from recent reports, unlikely to survive an earthquake. (**0030-4** [Swing, Carol])

Comment: The AP1000 design is flawed...and location dangerous. (**0049-2** [Ruthye100, You Tube Service])

Comment: Back in the US, a noted NRC engineer since the 1970's, Dr. John Ma, warned NRC commissioners that the Westinghouse AP 1000 reactor could "shatter like a glass cup," if put in stressful weather or seismic conditions. Of course, other engineers employed by Westinghouse insisted this was not the case. You can guess who was believed. (**0104-8** [Bliss, Rachel])

Comment: U. S. Rep Ed Markey, ranking member of the House Natural Resources Committee has said regarding the AP 1000 reactor: "Instead of doing all they should to protect nuclear reactors against seismically-induced ground acceleration, these Commissioners (NRC) voted to approve the acceleration of reactor construction. They have fast-tracked construction of a reactor whose shield building could 'shatter like a glass cup' if impacted by an earthquake or other natural or man-made impact." Back in May, NRC Chairman Gregory Jaczko expressed concerns with the AP 1000. He then said that Westinghouse would need to provide information on "additional technical issues" related to the AP 1000 shield building's ability to withstand accidents. A number of organizations still are not satisfied with Westinghouse's modifications. These groups include the AP 1000 Oversight Group, Bellefonte Efficiency and Sustainability Team, Blue Ridge Environmental Defense League, Citizens Allied for Safe Energy, Friends of the Earth, Georgia Women's Action for New Directions, Green Party of Florida, Mothers Against Tennessee River Radiation, North Carolina Waste Awareness and Reduction Network, Nuclear Information and Resource Service, Nuclear Watch South, South Carolina Chapter -Sierra Club, and Southern Alliance for Clean Energy. (**0104-9** [Bliss, Rachel])

Comment: [Building the W.S. Lee Nuclear Plant will:] Use the AP1000 reactor from fast tracked technology that has been built yet, makes it more dangerous to the public due to unknown variables. Rep. Ed Markey's report from scientists who have investigated the reactor shield and stated it could "shatter like a clas cup" if impacted by an earthquake or other natural or man-made disaster. In addition, the independent oversight group Fairewinds Associated listed concerns that the AP1000 design could release radiation directly into the air due to containment issues. Containment issues have been reported in 5 nuclear plants in the United States. (**0112-9** [Andrews, Josephine] [Anonymous] [Beattie, Kathryn E.] [Boever, Virginia] [Boyle, Ella] [Brogan Prindle, Cathleen] [Davis, John] [Flores, S.] [Hamahan, Clare] [Keil, A. Eugene] [Leverette, Will] [Peterson, Harry] [Peterson, Martha J.] [Rittenberg, David] [Rustin, K.])

Comment: AP1000 Westinghouse design is FLAWED and unsafe. (**0114-11** [Lovinsohn, Ruth])

Comment: The problem that the proposed AP1000 nuclear reactor is a new, untested design. (**0119-21** [Thomas, Ruth])

Comment: The AP1000 Westinghouse Reactor - remains a fast-tracked example of construction-never yet built-but proposed for new reactors in the Southeast. Its 'shield' building has been described as one that could "shatter like a glass cup" by earthquakes or man-made impact. (**0133-6** [Christopher, Lucy D.])

Comment: South Carolina is in an earthquake zone. Scientists have stated in a report to Rep. Ed Markey that the AP1000's reactor shield could "shatter like a glass cup" if earthquake impacted. (**0139-3** [Dailey, Debbie])

Response: *The NRC conducts a concurrent safety review of each COL application along with the environmental review; the results of the NRC's safety review of the Lee Nuclear Station will be published in an FSER, which is tentatively scheduled for publication in 2015. Regarding concerns about the viability of the AP1000 reactor design, approval of new reactor designs is contingent on the rigorous safety review of the design control document (DCD). New reactor construction is verified by inspections, tests, analyses, and acceptance criteria prior to initial startup testing and plant operation.*

The AP1000 reactor design underwent a lengthy and thorough safety review, resulting in issuance of the AP1000 Design Certification (DC) Final Rule in December 2011. The following schedule information is from the NRC's AP1000 amendment website located at http://www.nrc.gov/reactors/new-reactors/design-cert/amended-ap1000.html. This website and the AP1000 DC website (http://www.nrc.gov/reactors/new-reactors/design-cert/ap1000.html) provide links to Westinghouse's license amendment applications and the NRC's safety evaluation reports.

Comment: What about the costs of, for example, evacuating Charlotte which is within the 50-mile radius that we asked Americans in Japan to leave when Fukushima was melting down. Where are the costs for that? Oh, that won't happen because our design is safe. (**0012-8-5** [Crissey, Brian])

Comment: You know, I totally believe that you will do anything within your power to make it [nuclear power] safe. The problem is it's not safe. (**0013-26-2** [Sloan, Judie])

Comment: In addition, since South Carolina also has frequent tornadoes, what happens if the site is hit by one of those? I am not interested in discovering how far nuclear radiation can travel when borne on the winds of a hurricane or tornado. (**0030-5** [Swing, Carol])

Comment: We live just 60 miles from there and have many serious concerns about the safety of such an installation. (**0113-2** [Rose, Katherine])

Comment: The problems of human error and misconduct of workers. (**0119-3** [Thomas, Ruth])

Comment: Plainly stated, the operation of two nuclear reactors at this location would endanger over a 2.3 million people in two states living within 50 miles of the plant including the cities of Gaffney, Spartanburg, Greenville, Rock Hill, Gastonia, Charlotte and Hickory. Whatever safety measures are in place can never be sufficient because these facilities are, after all, operated by human beings. (**0130-1** [Zeller, Lou])

Comment: Although nuclear energy in supposed to be efficient, there is much evidence that it is not safe. Accidents at a nuclear plant fall within the quality improvement category of rare chance of accident, but devastating effect, if one should occur. I don't believe that our society in the US can even imagine what natural disasters could precipitate a nuclear accident. Witness the tsunami in Japan and the horrors that followed. I'm sure that there was no mention of a tsunami in the Japanese disaster plan. Similarly, US energy companies and their political partners are unlikely to look further than the next election cycle to imagine or plan for the safety impacts of accidents at a nuclear power plant. (**0132-2** [Cahill, Joanne])

Response: *In general, these comments express opposition to Lee Nuclear Station based on safety concerns, including natural disasters, human error, and terrorism. Safety issues are* *outside the scope of the Lee Nuclear Station environmental review and are not addressed in the EIS. However, the NRC conducts a concurrent safety review of each COL application along with the environmental review, and these issues are addressed in that review. The NRC is in the process of developing a safety evaluation report that analyzes all aspects of reactor and operational safety; the NRC staff's safety evaluation report for the proposed Lee Nuclear Station is anticipated to be published in 2015.*

With regards to Fukushima Dai-ichi, since the nuclear accident at Fukushima began to unfold, the NRC has been working to understand the events that took place in Japan and relay important information to U.S. nuclear power plant licensees and applicants. Not long after the emergency began, the NRC established a task force of senior NRC experts to determine lessons learned from the accident and to initiate a review of NRC regulations to determine if additional measures should be taken immediately to ensure the safety of U.S. nuclear power plants. The task force issued its report on July 12, 2011, concluding that continued U.S. nuclear plant operation and NRC licensing activities presented no imminent risk. The task force also concluded that enhancements to safety and emergency preparedness are warranted and made several general recommendations for Commission consideration. The NRC issued SECY 12-0025 (NRC 2012d), detailing the proposed Orders and required actions in response to lesson learned from Japan's March 11, 2011 earthquake and tsunami. For new reactors and COLs (such as Lee Nuclear Station), the staff will ensure that the Commission-approved Fukushima actions are addressed prior to licensing.

On March 9, 2012, the Commission directed the NRC staff to issue immediately effective Orders to U.S. commercial nuclear reactors to begin implementation of several recommendations for enhancing safety at U.S. reactors, based on lessons learned from the accident at Japan's Fukushima Dai-ichi nuclear power plant (see NRC News Release 12-023 at http://pbadupws.nrc.gov/docs/ML1206/ML120690627.pdf). Two of the Orders apply to every U.S. commercial nuclear power plant, including those under construction and the recently licensed new Vogtle and V.C. Summer reactors. The first Order requires plants to better protect safety equipment installed after the September 11, 2001 terrorist attacks and to obtain sufficient equipment to support all reactors at a given site simultaneously. The second Order requires plants to install enhanced equipment for monitoring water levels in each plant's spent fuel pool. The third Order applies only to U.S. boiling water reactors that have "Mark I" or "Mark II" containment structures. These reactors must improve venting systems (or, for the Mark II plants, install new systems) that help prevent or mitigate core damage in the event of a serious accident. Plants have until December 31, 2016, to complete modifications and requirements of all three Orders. The NRC also issued a detailed information request to every operating U.S. commercial nuclear power plant, and certain parts of this request will apply to reactors currently under construction or recently licensed.

Regarding concerns about the safety of the AP1000 reactor design, approval of new reactor *designs is contingent on the rigorous safety review of the DCD. New reactor construction is verified by inspections, tests, analyses, and acceptance criteria prior to initial startup testing and plant operation. The AP1000 reactor design underwent a lengthy and thorough safety review, resulting in issuance of the Final Rule for the AP1000 DC Amendment in December 2011 (ADAMS Accession No. ML113480014).*

Comment: Now, the environmental impact of the William States Lee can be summed up in one word: Fukushima, or maybe two when you add Chernobyl, or more: Three Mile Island. Actually there were 14 near misses in 2009 and 2010 in the U.S. alone, serious failures in which safety was jeopardized, the most significant being at the H.B. Robinson Plant owned by Progress Energy here in Hartville, South Carolina. (**0013-19-1** [Dailey, Debbie])

Comment: And more recently, there is Fukashima to remind us that accidents do happen in the most meticulately controlled situations. Because such a tragedy hasn't happened here yet does not mean that it can not happen here. (**0143-2** [McAfee, Patricia B.])

Comment: Today we're aware only of the occasional mishaps that make the news. There are 432 plants worldwide, and things happen all the time; there are incidents all the time. We're only aware of the ones that we hear from in the news like Browns Ferry, Davis- Besse, Fairmead, Diablo, San Onofre, Three Mile Island, Chernobyl, Indian Point, Fukushima, and very recently North Anna because of an earthquake. Imagine an earthquake in Virginia. The reports that I've read indicate that Three Mile Island was perhaps within 30 minutes of contaminating the entire northeastern part of the United States and making it unhabitable for centuries, if not forever. We know about Chernobyl that exploded to release radiation over much of Europe and eventually the entire globe. That's why we all have radioactive particles in our bodies. There's no way to control what's going on at Fukushima. It's probably already worse than Chernobyl and it's continuing as we speak. And don't talk to be me about nuclear safety. Given the cost -- well, think about Indian Point in New York. That is on an earthquake fault -- or close to an earthquake fault like the one at North Anna. there are 17 million people in the immediate environs of Indian Point and that would only be the beginning of the destruction. 17 million people are living close to Indian Point. (**0013-14-3** [Richardson, Don])

Comment: As you listen to those words think of Three Mile Island and Chernobyl and Fukushima. Ponder the possibility of the many near misses at nuclear plants the world over, the ones known only to those captains of the nuclear industry but kept hidden from public view. (**0013-15-1** [Guy, Peggy])

Comment: That [Chernobyl] was not a terrible planned event -- that was an accident of somebody flipping a switch the wrong way. This is not a benign, safe, pleasant little industry. This is something that can turn around and bite you badly. (**0013-27-1** [Fisk, Bill])

Comment: I'm concerned because should there be a breach of safety at this proposed nuclear plant -- I live 60 miles from here. If we look at what has taken place in Japan at Fukushima radiation has greatly impacted Tokyo, which is about 130 miles away from the Fukushima plant. This plant, should it have any kind of a destructive situation, would affect far more than the people in Cherokee County. It would affect the people in the entire Southeast; it would affect the people in the entire globe. The radiation from Fukushima traveled around the Earth. It affected every place in the United States, in fact to the point the radiation monitors were actually shut down to keep people from understanding what the impact would be. We have just tremendous impact from that one situation. We all hope, of course, that this would never happen at any nuclear plant. We hope that these disasters would not take place. But let's back at what has taken place in the year 2011 in this country alone. We have had tornadoes that have shut down nuclear plants, we have had flooding along the Mississippi River which greatly impact a plant -- the Fort Calhoun Plant. (**0013-5-1** [Cremer, Claudine])

Comment: Furthermore, the lessons of Chernobyl, Three-Mile Island, and now especially Fukushima must not be hidden away but rather paid attention to with extreme clarity. (**0046-4** [Southworth, Win])

Comment: The effects of the danger of radiation over time are irrefutable, as well as the danger in the event that anything goes wrong which has happened multiple times in the past in nuclear plants around the world. The danger to humans, the watershed & the ecosystem is unacceptable. (**0084-3** [Lemoing, Melissa])

Comment: After the recent Fukishima disaster we see proof again that it can happen - unanticipated natural disaster, human error & failings, terrorist threats, system malfunction can happen despite all the reassurances the nuclear industry & the NRC/Nuclear Regulatory Commission make. Toxic radiation knows no boundaries -Chernobyl radiation reached CA in 10 days. Thousands died & continue dying today. TMI came close to being worse than Chernobyl. Fukishima radiation fallout easily reached CA & our East coast. (**0092-5** [Howarth, Irma])

Comment: Those of us who have lived through the entire nuclear age are aware of the thousands of incidents, large and small, that have occurred at the world's 432 nuclear plants. (**0100-2** [Richardson, Don])

Comment: Today, we are aware of only the occasional mishap that makes the news, and we hear such names as Brown's Ferry, Davis Besse, Fermi, Diablo, San Onofre, TMI, Chernobyl, Indian Point, Fukushima, and very recently North Anna. TMI was reportedly close to a meltdown that might have made the entire NE of the US uninhabitable for centuries--or longer. Chernobyl exploded to release radiation over much of Europe and eventually the entire globe. Fukushima is now believed to be even worse than Chernobyl, with no way to control continuing releases of lethal rays and particles, now detectable in the US. (**0100-3** [Richardson, Don])

Comment: I was living in southern York County PA when the accident at Three Mile Island occurred. Later I heard numerous testimonies to negative impacts of radiation releases from 2-headed calves to misshaped vegetables to women losing their unborn babies. And now we learn about the meltdowns at Fukushima where the scale of the event ad to be raised from level 4 to level 7, the highest, the worse it can be. Children, the most vulnerable to radiation, were exposed to high levels, levels that were raised to 10 times the level causing cancer in nuclear weapons. (**0106-1** [Hearne, Ray])

Comment: The safety issue is an even bigger concern. We know that Fukushima sent fallout to Tokyo. Asheville/Candler where I live is three times closer to the proposed site in Gaffney. Research on Chernobyl shows that there are people of Belarus still suffering debilitating diseases as a Result of Contamination 124 miles away. (**0140-3** [G., Edith A.])

Response: *These comments express opposition to the proposed Lee Nuclear Station based on safety concerns. Comments primarily cite past nuclear accidents, including Chernobyl, Three Mile Island Unit 2, and Fukushima Dai-ichi. They do not provide any specific information related to the environmental effects of the proposed Lee Nuclear Station. Section 5.11 of the EIS considers the radiological consequences on the environment of potential accidents at the proposed Lee Nuclear Station. This section has been updated to include the recent Commission Orders related to the lessons learned from the accident at Japan's Fukushima Dai-ichi nuclear power plant. Issues related to safety are beyond the scope of the environmental review and will be evaluated in the Lee Nuclear Station FSER, which is tentatively scheduled to be published in 2015. Section E.2.38 in this appendix responds to similar comments against nuclear power in general that also cite the accidents at Chernobyl, Three Mile Island, and Fukushima Dai-ichi.*

Comment: Shut down could happen due to lack of water for cooling; a very dangerous occurence. (**0017-4** [Morgan, Tom and Barbara])

Response: *This comment expresses concern regarding drought conditions that could necessitate a shutdown of the proposed Lee Nuclear Station without sufficient water to safely do so. The EIS evaluates the potential effects of plant construction and operation on the environment, and does not evaluate safety impacts of the environment on the proposed plant. Therefore, these comments are not within the scope of the environmental review and no changes were made to the EIS. The staff's safety evaluation report will address the effects of drought on the plant. Nuclear power plants are extremely robust structures designed to safely shut down when necessary. If an extreme drought event causes the nuclear power plant to be shut down, the reactor can be maintained in a safe condition. Furthermore, the AP1000 reactor design does not require a water source to safely shut down the nuclear units.*

Comment: The problems associated with earthquakes, tornadoes, floods, fires, hurricanes, all weather conditions which contribute to disturbing cooling water use. (**0119-2** [Thomas, Ruth])

Response: *This comment expresses concern about the impacts of severe weather and earthquakes on the operation of the proposed Lee Nuclear Station. The EIS is concerned with the potential effects of plant construction and operation on the environment and does not evaluate safety impacts of the environment on the proposed plant. Therefore, this comment is not within the scope of the environmental review and no changes were made to the EIS as a result. The NRC staff's safety evaluation report will address the effects of weather and earthquakes on the plant. Nuclear power plants are designed to survive severe weather such as hurricanes and tornadoes. If an extreme weather event causes a nuclear power plant to be shut down, the reactor can be maintained in a safe condition. The likelihood of the maximum wind speed in a hurricane or tornado exceeding the design wind speed for a reactor and its safety-related systems is typically less than 1 in 10 million in any given year.*

With regard to the impact of earthquakes on the proposed Lee Nuclear Station, Section 2.5 of the NRC staff's FSER will provide a detailed description of the geologic features of the Lee Nuclear Station site and vicinity, and document the NRC staff's independent assessment of Duke's detailed evaluation and analysis of geological, seismological, and geotechnical data. The peak acceleration rate at the site would be evaluated as part of the design basis for siting the AP1000 reactor design at the proposed Lee Nuclear Station site.

Furthermore, if the proposed Lee Nuclear Station was forced to safely shutdown due to weather or seismic conditions, the AP1000 reactor design does not require a water source.

Comment: Corporate greed is another predictable variable that can affect safety of nuclear plants. All the regulations in the world will not prevent a corporation for skimping on safety procedures to maximize profits. There are too many examples in every industry of corporate greed trumping public interest to even list. (**0132-3** [Cahill, Joanne])

Response: *This comment addresses safety issues at nuclear facilities that could be caused by improper oversight by the licensee. Operational safety issues are outside the scope of the environmental review and will not be addressed in the EIS. The safety implications would be considered in the NRC's separate safety review of the project and described in the FSER. The NRC has an operational experience program that ensures that safety issues that are found at one plant are properly addressed at all others, as appropriate. No change was made to the EIS as a result of this comment.*

Comment: South Carolina is in one of the most active earthquake zones in the nation, and I have a USGS map showing -- and I'll leave a copy of this -- where the earthquakes have occurred in the United States in the last 200 or so years. Oddly enough, these same areas of South Carolina are where many of the nuclear plants are located. (**0012-10-2** [Connolly, Mary Ellen])

Comment: I also have on the earthquake thing, there has been an earthquake, it was January 9 of 2012, it was located near Charleston at that point, but this is the map that shows the clusters of the earthquakes, and this is a list from the USGS of the earthquake history of this area. There's been one in Pendleton, Pickens, all over. This is a dangerous plant and we need it stopped now. (**0012-10-7** [Connolly, Mary Ellen])

Comment: We have had earthquakes that affected the North Anna plant in the state of Virginia. It cracked the containment building there. We have had flooding, as I mentioned. As well intentioned as human beings are we cannot regulate or control nature. And I think that's the bottom line here. (**0013-5-2** [Cremer, Claudine])

Comment: Like Japan, we live on fault lines here in Western North Carolina and Upstate South Carolina. We are at risk for a seismic event which could cause irreparable damage to the Nuclear Power Stations in our region. (**0048-3** [Skeele, Michele and Skip])

Comment: An earthquake in Virginia has damaged the plants at North Anna, which, like Indian Point in NY, are on or close to fault lines. (**0100-4** [Richardson, Don])

Comment: Back in 1913, Union County, just one county south of Gaffney's Cherokee County, experienced a 5.5 earthquake. There is no basis to say that there won't be another. (**0104-1** [Bliss, Rachel])

Comment: I find it very disturbing that the NRC is considering allowing the construction of new nuclear stations in light of the Fukushima disaster of last year and the near catastrophe at Ft. Calhoun last summer. As the Fukushima disaster showed, the nuclear plant's core facilities were damaged and destroyed not by the tsunami, but by the earthquake. The vast majority of nuclear power plants in this country were not built with any consideration of threats from earthquakes, but just last year an earthquake shook the east coast. The Madrid Fault Zone is expected to become active in the near future. (**0111-1** [Knudten, Cori])

Comment: As the recent events in Fukishima, Japan indicate, major earth upheavals can occur anywhere, with little notice, and can devastate a nuclear plant and the communities around it. One year later Fukishima is STILL spewing radiation into the air and into the ground water, affecting all of Japan, the Pacific Ocean and eventually the entire planet. (**0113-6** [Rose, Katherine])

Comment: We all have to have concerns about safety when we look at the use of nuclear energy failed plants have contributed significant danger to communities worldwide. From Three Mile Island, Chernobyl, to Fukushima, populations have been exposed to health risk by exposure. This plant is 60 miles from Asheville, which is located along a seismological fault area. Leakage is likely to affect children as well as adults. (**0122-2** [Justice, Cynthia and Michael])

Comment: Design - Modern designs for safety must be undertaken to prevent earthquake damage. (**0122-6** [Justice, Cynthia and Michael])

Comment: South Carolina is an Active Earthquake Zone
The National Earthquake Information Center reports over 20 earthquakes of intensity V or greater (5 or more on a scale of 10 in the Modified Mercalli scale) have been centered in the state. The famous Charleston earthquake of 1886 was an intensity X which damaged building 100 miles away. The map at right indicates the magnitude and the extent of the 1886 quake.

The University of South Carolina's Seismic Network contains comprehensive data on earthquake history.

The seismic history of the southeastern United States is dominated by the 1886 earthquake that occurred in the Coastal Plain near Charleston, South Carolina. It was one of the largest historic earthquakes in eastern North America, and by far the largest earthquake in the southeastern United States. A major shock, occurred August 31, 1886 at approximately 9:50p.m. and lasted less than one minute, but resulted in about sixty deaths and extensive damage to the city of Charleston. Because the event took place before seismological instrumentation, estimates of its location and size must come from observations of the damage and effects caused by the earthquake. Most of what we know of the even and the resulting damage comes from a comprehensive report by C.E. Dutton of the U.S. Geological Survey published in 1889. The meizoseismal area (area of maximum damage) of the 1886 earthquake is an elliptical area roughly 20 by 30 miles trending northeast between Charleston and Jedburg and including Summerville and roughly centered at Middleton Place.

The 1886 earthquake was followed by a series of aftershocks. Of 435 or more earthquakes reported to have taken place in South Carolina between 1754 and 1975, more than 300 were aftershocks that occurred in the first 35 years following 1886. The 1886 earthquake and its aftershocks dominate the seismic record of the southeast.

The historic record suggests the Charleston-Summerville area had a continuum of low level seismicity prior to 1886, and a low-level activity continues in the same area today.

In 1903 a quake centered in the Savannah River area was recorded at an intensity of VI. In 1907 a quake again affected Charleston, Augusta, and Savannah. Quakes occurred in 1912, 1913 and 1914. In 1924 an earthquake affecting an area of 50,000 square miles shook most of South Carolina. In 1945 a shock centered west of Columbia was felt as far away as Georgia and Tennessee. More quakes occurred in 1952, 1959, 1960 and 1967. A magnitude 3.4 (Richter scale) earthquake centered near Orangeburg in 1971.

The map at right illustrates seismic events from 1990 to 2006. On the map, circles are earthquakes, color represents depth range and depth is in kilometers. Purple indicates cities. Earthquake locations are from the USGS/NEIC PDE catalog.

Earthquakes are measured in terms of acceleration with respect to gravity. Gravity's acceleration is 32 feet per second per second. The peak acceleration is the largest recorded during a particular earthquake. Geologic faults are commonly considered to be active if they have moved one or more times in the last 10,000 years.

South Carolina Seismic Hazard Map

The South Carolina Geological Survey states:

When will the next strong quake occur? The ability to accurately predict when and where earthquakes will occur is not yet available. South Carolinians need to realize that South Carolina faces the possibility of the occurrence of a strong quake having its epicenter within our borders. We also need to realize that a major earthquake anywhere in the Eastern United States could adversely affect us, causing damage.

Nuclear engineers use "probabilistic" techniques to describe ground motion potential. They attempt to account for all potential seismic sources in the region around the plant. The standard is ground motion (**0130-7** [Zeller, Lou])

Comment: Section 5.11.2.4 discusses Externally Initiated Events, and should address the largest anticipated earthquake at the site, based on current data and state of the art technology. The Charleston earthquake of the 1800s should be referenced, and how this would have impacted the proposed site of the reactors. The peak acceleration rate at the site based on the Charleston earthquake should be addressed. (**0142-7** [Mueller, Heinz])

Response: *The EIS is concerned with the potential effects of plant construction and operation on the environment and does not evaluate safety impacts of the environment on the proposed plant. The safety implications would be considered in the NRC's separate safety review of the project and described in the FSER. Therefore, this comment is not within the scope of the environmental review and no changes were made to the EIS as a result. The geology of the Lee Nuclear Station site is described only briefly in the EIS. Section 2.5 of the NRC staff's FSER will provide a detailed description of geologic features of the Lee Nuclear Station site and vicinity, and will document the NRC staff's independent assessment of Duke's detailed analysis of geological, seismological, and geotechnical data, including the Charleston seismic zone source. As such, the peak acceleration rate at the Lee Nuclear Station site would be evaluated as part of the design basis for siting the AP1000 reactor design at the proposed site near Gaffney, South Carolina. The site-specific response of the certified AP1000 design must still meet the seismic conditions evaluated during the design certification process. As provided in*

Section 5.11.2.4 of the EIS, the NRC staff concluded in the Design Certification's FSER that the AP1000 reactor design is seismically acceptable. No changes were made to the EIS as a result of these comments.

E.2.34 Comments Concerning Issues Outside Scope - Security and Terrorism

Comment: Now, even if everyone were to run smoothly, as they say that it will, there is a growing risk of cyber weapon technology attacks, as shown by the computer virus Stuxnet, which infiltrated the industrial control system of an Iranian nuclear power plant, causing physical damage. (**0013-19-2** [Dailey, Debbie])

Comment: The risk of fissionable material getting into terrorists control adds greatly to these other dangers. (**0019-3** [Doebber, Tom], **0020-3** [Klein, Art and Michelle], **0026-2** [Doebber, Ian] [Doebber, Rachel])

Comment: Nuclear power generation provides a target for terrorists. (**0024-5** [Whitefield, Anne])

Comment: The problem of the expense of protecting against terrorism. (**0119-15** [Thomas, Ruth])

Comment: The problem that so long as there are nuclear power plants anywhere, nuclear weapons are possible. (**0119-24** [Thomas, Ruth])

Comment: Finally, in an age of large potential for terrorism the construction of a large central and highly vulnerable power plant rather than multiple smaller distributed power generation sources simply makes no sense. (**0124-5** [Hayes, MD, J. David])

Response: *The EIS is concerned with the potential effects of plant construction and operation on the environment and does not evaluate safety impacts of the environment on the proposed plant. Therefore, this comment is not within the scope of the environmental review and no changes were made to the EIS as a result. Security and terrorism are safety issues that are not within the scope of the staff's environmental review. Safety implications would be considered in the NRC's separate safety review of the project and described in the FSER. The NRC is devoting substantial time and attention to terrorism-related matters, including coordination with the U.S. Department of Homeland Security. As part of its mission to protect public health and safety and the common defense and security pursuant to the Atomic Energy Act of 1954, the NRC staff is conducting vulnerability assessments for the domestic utilization of radioactive material. Since the events of September 11, 2001, the NRC has identified the need for license holders to implement compensatory measures and has issued several Orders to license holders imposing enhanced security requirements. Finally, the NRC has taken actions to ensure that applicants and license holders maintain vigilance and a high degree of security awareness. The NRC will continue to consider measures to prevent and mitigate the consequences of acts of* *terrorism in fulfilling its safety mission. Additional information about the NRC staff's actions regarding physical security since September 11, 2001 can be found on the NRC's public website at http://www.nrc.gov/security.html.*

E.2.35 General Editorial Comments

Comment: Section 4.9.2, Page 4-108, Line 34: The DEIS states "...to compute doses to persons at the proposed Unit 2 protected area fence." This should be "...at the proposed Unit 1 protected area fence." (**0134-48** [Fallon, Chris])

Response: *The text in Section 4.9.2 was corrected.*

Comment: Section 5.9.5.2, Page 5-80, Lines 3-5: Since the Ninety-Nine Islands dam is located to the southeast of the station, the reference of "southwest" should be "southeast." (**0134-56** [Fallon, Chris])

Response: *The text in Section 5.9.5.2 was corrected.*

Comment: Section 6.3, Page 6-41, Line 25: GEIS-DECON should be GEIS-DECOM. (**0134-57** [Fallon, Chris])

Response: *The text in Section 6.3 was corrected.*

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10 CFR Part 51. *Code of Federal Regulations*, Title 10, *Energy*, Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.”

10 CFR Part 52. *Code of Federal Regulations*, Title 10, *Energy*, Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants.”

10 CFR Part 63. *Code of Federal Regulations*, Title 10, *Energy*, Part 63. “Disposal of High-Level Radioactive Wastes in a Geological Repository at Yucca Mountain, Nevada.”

10 CFR Part 71. *Code of Federal Regulations*, Title 10, *Energy*, Part 71, “Packaging and Transportation of Radioactive Material.”

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33 CFR Part 332. *Code of Federal Regulations*, Title 33, *Navigation and Navigable Waters,* Part 332, "Compensatory Mitigation for Losses of Aquatic Resources."

40 CFR Part 125. *Code of Federal Regulations*, Title 40, *Protection of Environment*, Part 125, "Criteria and Standards for the National Pollutant Discharge Elimination System."

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Duke Energy Carolinas, LLC (Duke). 2012d. Letter from Christopher Fallon, Duke, to NRC dated April 30, 2012, "Duke Energy Carolinas, LLC, William States Lee III Nuclear Station--Docket Nos. 52-018 and 52-019, AP1000 Combined License Application for the William States Lee III Nuclear Station Units 1 and 2, Supplemental Response to Request for Additional Information Ltr#WLG2012.04-08." Accession No. ML12123A714.

Duke Energy Carolinas, LLC (Duke) 2012e Letter from Robert Wylie, Duke, to South Carolina Department of Health and Environmental Control Water Quality Certification and Wetlands Section dated August 30, 2012, "William States Lee III Nuclear Station Public Notice No.: 2009-122-SIR Request for Additional Information." Accession Number ML12255A448).

Duke Energy Carolinas, LLC (Duke). 2012f. Letter from Robert Wylie, Duke, to South Carolina Department of Health and Environmental Control Water Quality Certification and Wetlands Section dated September 26, 2012, "William States Lee III Nuclear Station Public Notice No.: 2009-122-SIR Request for Additional Information." Accession No. ML13221A013.

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Appendix F

Key Consultation Correspondence

Appendix F

Key Consultation Correspondence

Correspondence sent and received during the environmental review of the combined licenses application for the William States Lee III Nuclear Station, Units 1 and 2 is identified in Table F-1. The correspondence can be found in NRC's Agencywide Document Access and Management System (ADAMS), which is accessible from the NRC website at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room) (note that the URL is case-sensitive). ADAMS accession numbers are also provided in Table F-1.

Table F-1. Key Consultation Correspondence

Source	Recipient	Date of Letter and ADAMS Accession Number
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	Advisory Council on Historic Preservation (Mr. Don Klima)	April 9, 2008 ML080840472
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	South Carolina Archives and History Center, State Historic Preservation Office (Ms. Elizabeth Johnson)	April 9, 2008 ML080840533
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	U.S. Fish and Wildlife Service (Mr. Sam Hamilton)	April 9, 2008 ML080840475
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	National Oceanic and Atmospheric Administration–National Marine Fisheries Service (Mr. David M. Bernhart)	April 9, 2008 ML080850962
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	Catawba Indian Nation, Tribal Historic Preservation Office (Dr. Wenonah Haire)	April 9, 2008 ML080840506
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	Eastern Band of the Cherokee Indians, Tribal Historic Preservation Office (Mr. Russell Townsend)	April 9, 2008 ML080840513
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	Carolina Indian Heritage Association (Ms. Michelle Pounds)	April 9, 2008 ML080840519

Table F-1. (contd)

Source	Recipient	Date of Letter and ADAMS Accession Number
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	Eastern Shawnee Tribe of Oklahoma (Chief Glenna J. Wallace)	April 9, 2008 ML080840520
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	United South and Eastern Federation of Tribes (Mr. Michael Cook)	April 9, 2008 ML080840538
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	Piedmont American Indian Association, Lower Eastern Cherokee Nation South Carolina (Chief Gene Norris)	April 9, 2008 ML080840540
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	Pine Hill Indian Community (Ms. Michelle Pounds)	April 9, 2008 ML080840545
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	North Carolina Wildlife Resources Commission, Habitat Conservation Program (Mr. Ron Linville)	April 11, 2008 ML080880253
National Oceanic and Atmospheric Administration–National Marine Fisheries Service (Mr. David M. Bernhart)	U.S. Nuclear Regulatory Commission	May 5, 2008 ML081400585
South Carolina Department of Archives and History, State Historic Preservation Office (Ms. Rebekah Dobrasko)	U.S. Nuclear Regulatory Commission (Mr. Richard Raione and Ms. Linda Tello)	May 12, 2008 ML081510939
U.S. Fish and Wildlife Service (Mr. Timothy Hall)	U.S. Nuclear Regulatory Commission	May 13, 2008 ML081430228
North Carolina Wildlife Resources Commission (Mr. Christopher Goudreau)	U.S. Nuclear Regulatory Commission	May 20, 2008 ML081430390
South Carolina Department of Natural Resources, Office of Environmental Programs (Mr. Robert D. Perry)	U.S. Nuclear Regulatory Commission	May 20, 2008 ML081430553
U.S. Fish and Wildlife Service (Mr. Timothy Hall)	U.S. Nuclear Regulatory Commission	May 21, 2008 ML081540399
South Carolina Department of Archives and History, State Historic Preservation Office (Ms. Rebekah Dobrasko)	U.S. Nuclear Regulatory Commission (Ms. Linda Tello)	May 30, 2008 ML081510453

Table F-1. (contd)

Source	Recipient	Date of Letter and ADAMS Accession Number
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	Seminole Tribe of Florida, Tribal Historic Preservation Office (Mr. Willard Steele)	June 4, 2008 ML081430691
Catawba Indian Nation, Tribal Historic Preservation Office (Dr. Wenonah Haire)	U.S. Nuclear Regulatory Commission	June 11, 2008 ML081750079
U.S. Nuclear Regulatory Commission (Mr. Richard Raione)	South Carolina Department of Natural Resources, Heritage Trust Program (Ms. Julie Holling)	June 19, 2008 ML081420749
South Carolina Department of Natural Resources, Heritage Trust Program (Ms. Julie Holling)	U.S. Nuclear Regulatory Commission	July 8, 2008 ML081990424
Eastern Band of Cherokee Indians, Tribal Historic Preservation Office (Mr. Tyler B. Howe)	U.S. Nuclear Regulatory Commission	November 20, 2008 ML083370297
U.S. Army Corps of Engineers, Charleston District (LTC J. Richard Jordan III)	U.S. Nuclear Regulatory Commission	February 10, 2009 ML090690283
Catawba Indian Nation, Tribal Historic Preservation Office (Dr. Wenonah Haire)	U.S. Nuclear Regulatory Commission	February 19, 2009 ML090840061
U.S. Nuclear Regulatory Commission (Mr. Scott Flanders)	U.S. Army Corps of Engineers, Charleston District (LTC J. Richard Jordan III)	March 30, 2009 ML090700384
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	South Carolina Archives and History Center, State Historic Preservation Office (Ms. Caroline Dover Wilson)	May 24, 2010 ML093480445
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	Advisory Council on Historic Preservation (Mr. Don Klima)	May 24, 2010 ML093560024
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	South Carolina Department of Natural Resources, Office of Environmental Programs (Mr. Robert D. Perry)	May 24, 2010 ML093570175
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	U.S. Fish and Wildlife Service, Southeast Region (Mr. Jay B. Herrington)	May 24, 2010 ML093580019

Table F-1. (contd)

Source	Recipient	Date of Letter and ADAMS Accession Number
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	North Carolina Wildlife Resources Commission, Habitat Conservation Program (Mr. Ron Linville)	May 24, 2010 ML101190491
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	South Carolina Department of Health and Environmental Control (Ms. Susan Turner)	May 24, 2010 ML101190500
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	U.S. Environmental Protection Agency, Region 4, National Environmental Policy Act Program Office	May 24, 2010 ML101200120
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	Catawba Indian Nation, Tribal Historic Preservation Office (Dr. Wenonah Haire)	May 24, 2010 ML101200150
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	Seminole Tribe of Florida, Tribal Historic Preservation Office (Mr. Willard Steele)	May 24, 2010 ML101200368
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	Eastern Band of the Cherokee Indians, Tribal Historic Preservation Office (Mr. Russell Townsend)	May 24, 2010 ML101200371
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	Eastern Shawnee Tribe of Oklahoma (Chief Glenna J. Wallace)	May 24, 2010 ML101200375
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	Carolina Indian Heritage Association (Ms. Michelle Pounds)	May 24, 2010 ML101200416
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	United South and Eastern Federation of Tribes (Mr. Michael Cook)	May 24, 2010 ML101200435
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	Piedmont American Indian Association, Lower Eastern Cherokee Nation South Carolina (Chief Gene Norris)	May 24, 2010 ML101200443
U.S. Nuclear Regulatory Commission (Mr. Robert Schaaf)	Pine Hill Indian Community (Ms. Michelle Pounds)	May 24, 2010 ML101200452
South Carolina Archives and History Center, State Historic Preservation Office (Ms. Caroline Dover Wilson)	U.S. Nuclear Regulatory Commission (Ms. Sarah Lopas)	June 21, 2010 ML101720651

Table F-1. (contd)

Source	Recipient	Date of Letter and ADAMS Accession Number
Catawba Indian Nation, Tribal Historic Preservation Office (Dr. Wenonah Haire)	U.S. Nuclear Regulatory Commission (Mr. Scott Flanders)	July 22, 2010 ML102110494
South Carolina Department of Natural Resources (Ms. Vivianne Vejdani)	U.S. Nuclear Regulatory Commission	July 27, 2010 ML102160393
U.S. Nuclear Regulatory Commission (Mr. Brian Hughes)	Bureau of Land and Waste Management, South Carolina Department of Health and Environmental Control (Ms. Sandra J. Threatt)	November 19, 2010 ML103150012
U.S. Nuclear Regulatory Commission (Mr. Allen Fetter)	Catawba Indian Nation (Dr. Wenonah Haire)	March 14, 2011 ML103000023
South Carolina Department of Natural Resources (Mr. Bob Perry)	U.S. Nuclear Regulatory Commission (Ms. Sarah Lopas)	May 2, 2011 ML111220594
Pacific Northwest National Laboratory (Mr. Jim Becker, for the U.S. Nuclear Regulatory Commission)	South Carolina Department of Natural Resources, Heritage Trust Program (Ms. Julie Holling)	May 25, 2011 ML111470774
Pacific Northwest National Laboratory (Mr. Jim Becker, for the U.S. Nuclear Regulatory Commission)	North Carolina Department of Environment and Natural Resources, Natural Heritage Program (Mr. Harry LeGrand)	May 25, 2011 ML114470794
South Carolina Department of Natural Resources, Heritage Trust Program (Ms. Julie Holling)	U.S. Nuclear Regulatory Commission	June 8, 2011 ML111741378
North Carolina Department of Environment and Natural Resources, Natural Heritage Program (Mr. John Finnegan)	U.S. Nuclear Regulatory Commission	June 23, 2011 ML111741383
Eastern Band of Cherokee Indians, Tribal Historic Preservation Office (Mr. Tyler B. Howe)	U.S. Nuclear Regulatory Commission (Ms. Sarah Lopas)	September 13, 2011 ML112570445
U.S. Nuclear Regulatory Commission (Ms. Sarah Lopas)	U.S. Federal Energy Regulatory Commission (Mr. Thomas J. LoVullo)	October 4, 2011 ML112790295
U.S. Federal Energy Regulatory Commission (Mr. Thomas J. LoVullo)	U.S. Nuclear Regulatory Commission (Mr. Allen H. Fetter)	October 5, 2011 ML112790296

Table F-1. (contd)

Source	Recipient	Date of Letter and ADAMS Accession Number
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	U.S. Environmental Protection Agency (Office of Federal Activities)	December 12, 2011 ML112940260
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	U.S. Environmental Protection Agency (Ms. Ramona McConney)	December 12, 2011 ML11319A023
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	Advisory Council on Historic Preservation (Mr. Reid Nelson)	December 12, 2011 ML11332A003
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	U.S. Fish and Wildlife Service (Mr. Jay B. Herrington)	December 12, 2011 ML11332A001
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	Eastern Band of Cherokee Indians, Tribal Historic Preservation Office (Mr. Russell Townsend)	December 12, 2011 ML11332A006
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	Catawba Indian Nation, Tribal Historic Preservation Office (Dr. Wenonah G. Haire)	December 12, 2011 ML11332A005
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	United South and Eastern Federation of Tribes (Mr. Michael Cook)	December 12, 2011 ML11332A061
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	Carolina Indian Heritage Association (Ms. Michelle Pounds)	December 12, 2011 ML11332A004
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	Seminole Tribe of Florida, Tribal Historic Preservation Office (Mr. Willard Steele)	December 12, 2011 ML11332A104
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	Eastern Shawnee Tribe of Oklahoma (Chief Glenna J. Wallace)	December 12, 2011 ML11332A007
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	Piedmont American Indian Association (Chief Gene Norris)	December 12, 2011 ML11332A008
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	Pine Hill Indian Community (Ms. Michelle Pounds)	December 12, 2011 ML11332A011
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	South Carolina Department of Archives and History, State Historic Preservation Office (Ms. Rebekah Dobrasko)	December 12, 2011 ML11332A002
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	South Carolina Department of Natural Resources, Office of Environmental Programs (Mr. Robert D. Perry)	December 12, 2011 ML11314A229

Table F-1. (contd)

Source	Recipient	Date of Letter and ADAMS Accession Number
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	South Carolina Department of Health and Environmental Control (Ms. Susan Turner)	December 12, 2011 ML11313A167
U.S Nuclear Regulatory Commission (Mr. William F. Burton)	North Carolina Wildlife Resources Commission, Division of Inland Fisheries (Mr. Christopher Goudreau)	December 12, 2011 ML11319A017
South Carolina Archives and History Center, State Historic Preservation Office (Ms. Rebekah Dobrasko)	U.S. Nuclear Regulatory Commission (Ms. Cindy Bladey)	January 20, 2012 ML12048A6711
U.S. Department of Interior, Office of Environmental Policy and Compliance (Ms. Joyce Stanley)	U.S. Nuclear Regulatory Commission (Ms. Cindy Bladey)	February 29, 2012 ML12083A060
U.S. Fish and Wildlife Service (Mr. Jay B. Herrington)	U.S. Nuclear Regulatory Commission	March 5, 2012 ML12083A064
South Carolina Department of Natural Resources, Office of Environmental Programs (Mr. Robert D. Perry)	U.S. Nuclear Regulatory Commission	March 6, 2012 ML12083A059
U.S. Fish and Wildlife Service (Mr. Jay B. Herrington)	U.S. Army Corps of Engineers, Charleston District (LTC Edward P Chamberlayne)	March 6, 2012 ML13317B884
National Oceanic and Atmospheric Administration–National Marine Fisheries Service (Ms. Virginia M Fay)	U.S. Army Corps of Engineers, Charleston District (LTC Edward P Chamberlayne)	March 6, 2012 ML13317A347
South Carolina Department of Natural Resources (Mr. Bob Perry)	U.S. Army Corps of Engineers (Dr. Richard Darden) and South Carolina Department of Health and Environmental Control (Ms. Alicia Rowe)	March 6, 2012 ML13319A630
U.S Environmental Protection Agency, National Environmental Policy Act Program Office (Mr. Heinz J. Mueller)	U.S. Nuclear Regulatory Commission	March 16, 2012 ML120790121
U.S. Fish and Wildlife Service (Mr. Jay B. Herrington)	U.S. Nuclear Regulatory Commission (Ms. Sarah Lopas)	June 13, 2012 ML12221A475
U.S. Nuclear Regulatory Commission (Mr. William F. Burton)	National Oceanic and Atmospheric Administration–National Marine Fisheries Service (Mr. David M. Bernhart)	August 14, 2012 ML12173A383

Table F-1. (contd)

Source	Recipient	Date of Letter and ADAMS Accession Number
U.S. Army Corps of Engineers (Dr. Richard Darden)	Duke Energy (Mr. Robert Wylie), South Carolina State Historic Preservation Officer (Ms. Rebekah Dobrasko), Catawba Indian Nation (Ms. Wenonah Haire), U.S. Nuclear Regulatory Commission (Ms. Patricia Vokoun) and Ms. Laura Boos	January 10, 2013 ML13213A408
South Carolina Archives and History Center, State Historic Preservation Office (Ms. Rebekah Dobrasko)	U.S. Army Corps of Engineers (Dr. Richard Darden)	April 3, 2013 ML13220A505
North Carolina Natural Heritage Program, Office of Conservation, Planning and Community Affairs (John Finnegan)	Pacific Northwest National Laboratory, Jim Becker	August 1, 2013 ML13213A439; ML13213A450
U.S. Fish and Wildlife Service, Georgia Ecological Services Field Offices (Pete Pattavina)	Pacific Northwest National Laboratory, Jim Becker	September 25, 2013 ML13317B647

Appendix G

Supporting Documentation on Radiological Dose Assessment and Historic and Cultural Resources

Appendix G

Supporting Documentation on Radiological Dose Assessment and Historic and Cultural Resources

The U.S. Nuclear Regulatory Commission (NRC) performed an independent dose assessment of the radiological impacts resulting from normal operation of the proposed new nuclear units at the William States Lee III Nuclear Station (Lee Nuclear Station) site. The results of this assessment are presented in this appendix and are compared to the results from Duke Energy Carolinas, LLC (Duke) found in Section 5.9, Radiological Impacts of Normal Operations. The appendix is divided into five sections: (1) dose estimates to the public from liquid effluents, (2) dose estimates to the public from gaseous effluents, (3) cumulative dose estimates, (4) dose estimates to the biota from liquid and gaseous effluents, and (5) historic and cultural resources at the Lee Nuclear Station, Make-Up Pond C, and ancillary facility sites.

G.1 Dose Estimates to the Public from Liquid Effluents

The NRC staff used the dose assessment approach specified in Regulatory Guide 1.109 (NRC 1977) and the LADTAP II computer code (Strenge et al. 1986) to estimate doses to the maximally exposed individual (MEI) and population from the liquid effluent pathway of the proposed Lee Nuclear Station Units 1 and 2. The NRC staff used the projected radioactive effluent release values for the Westinghouse Advanced Passive 1000 (AP1000) reactor to estimate doses to the MEI and population from liquid effluent releases from the proposed Lee Nuclear Station Units 1 and 2 (Westinghouse 2011).

G.1.1 Scope

Doses from the proposed Lee Nuclear Station Units 1 and 2 to the MEI were calculated and compared to regulatory criteria for the following:

- Total Body – Dose was the total for all pathways (i.e., drinking water, fish consumption, shoreline usage, swimming exposure, and boating) with the highest value for the adult, teen, child, or infant compared to the 3 mrem/yr per reactor design objective in Title 10 of the *Code of Federal Regulations* (CFR), Part 50, Appendix I.
- Organ – Dose was the total for each organ for all pathways (i.e., drinking water, fish consumption, shoreline usage, swimming exposure, and boating) with the highest value for the adult, teen, child, or infant compared to the 10 mrem/yr per reactor design objective specified in 10 CFR Part 50, Appendix I.

The NRC staff reviewed the assumed exposure pathways and the input parameters and values used by Duke (Duke 2009a, b, 2013a) for appropriateness, including references made to the Design Certification Document for the AP1000 (Westinghouse 2011). Default values from Regulatory Guide 1.109 (NRC 1977) were used when input parameters were not available. The NRC staff concluded that the assumed exposure pathways were appropriate; drinking water withdrawal from the Broad River does not occur before approximately 21 river miles downstream of the site. In addition, the input parameters and values used by Duke were generally appropriate.

G.1.2 Resources Used

To calculate doses to the public from liquid effluents, the NRC staff used a personal computer version of the LADTAP II code entitled NRCDOSE, Version 2.3.13 (Chesapeake Nuclear Services, Inc. 2006) obtained through the Oak Ridge Radiation Safety Information Computational Center (RSICC) with updates to the user interface obtained directly from Chesapeake Nuclear Services.

G.1.3 Input Parameters

Table G-1 provides a listing of the major parameters used in calculating dose to the public from liquid effluent releases during normal operation.

G.1.4 Comparison of Results

The results documented in the environmental report (ER) submitted by Duke (Duke 2009a) and the Final Safety Analysis Report (FSAR) (Duke 2013a) for doses from liquid effluent releases are compared in Table G-2 with the results calculated by the NRC staff. The doses calculated by the NRC staff are uniformly a factor of 1.37 times larger than doses calculated by Duke.

This is a direct result of the selection by the NRC staff of a smaller mean average flow rate of the Broad River than that used by Duke. The NRC staff used a value of 1858 cfs for the water years 2000 to 2010 measured at the U.S. Geological Survey gage at Ninety-Nine Islands Dam (USGS 2010); Duke used a longer-term average of 2538 cfs in its estimates (Duke 2009a).

For calculating the population dose from liquid effluents, Duke used the population distribution for 2036. However, Section 5.4.1 of the NRC's Environmental Standard Review Plan (ESRP) (NRC 2000) requires use of "... projected population for 5 years from the time of the licensing action under consideration." Because the population is increasing, the use of the year 2036 is conservative as long as operations at the site begin before then, so the NRC staff also used the year 2036 for comparisons.

Table G-1. Parameters Used in Calculating Dose to the Public from Liquid Effluent Releases

Parameter	NRC Values		Comments
New unit liquid effluent source term (Ci/yr)[(a)]	H-3	1.01×10^{3}	Values from Westinghouse AP1000 Design Control Document Table 11.2-7 for a single unit (Westinghouse 2011).
	Na-24	1.63×10^{-3}	
	Cr-51	1.85×10^{-3}	
	Mn-54	1.30×10^{-3}	
	Fe-55	1.00×10^{-3}	
	Fe-59	2.00×10^{-4}	
	Co-58	3.36×10^{-3}	
	Co-60	4.40×10^{-4}	
	Zn-65	4.10×10^{-4}	
	Br-84	2.00×10^{-5}	
	Rb-88	2.70×10^{-4}	
	Sr-89	1.00×10^{-4}	
	Sr-90	1.00×10^{-5}	
	Sr-91	2.00×10^{-5}	
	Y-91m	1.00×10^{-5}	
	Y-93	9.00×10^{-5}	
	Zr-95	2.30×10^{-4}	
	Nb-95	2.10×10^{-4}	
	Mo-99	5.70×10^{-4}	
	Tc-99m	5.50×10^{-4}	
	Ru-103	4.93×10^{-3}	
	Ru-106	7.35×10^{-2}	
	Ag-110m	1.05×10^{-3}	
	Te-129m	1.20×10^{-4}	
	Te-129	1.50×10^{-4}	
	Te-131m	9.00×10^{-5}	
	Te-131	3.00×10^{-5}	
	Te-132	2.40×10^{-4}	
	I-131	1.41×10^{-2}	
	I-132	1.64×10^{-3}	
	I-133	6.70×10^{-3}	
	I-134	8.10×10^{-4}	
	I-135	4.97×10^{-3}	
	Cs-134	9.93×10^{-3}	
	Cs-136	6.30×10^{-4}	
	Cs-137	1.33×10^{-2}	
	Ba-140	5.52×10^{-3}	
	La-140	7.43×10^{-3}	
	Ce-141	9.00×10^{-5}	
	Ce-143	1.90×10^{-4}	
	Ce-144	3.16×10^{-3}	
	Pr-143	1.30×10^{-4}	
	Pr-144	3.16×10^{-3}	
	W-187	1.30×10^{-4}	
	Np-239	2.40×10^{-4}	

Table G-1. (contd)

Parameter	NRC Values	Comments
Discharge flow rate (ft^3/s)	13.4	Site-specific value from Table 5.4-2 of the ER (Duke 2009a) and Table 11.2-202 of the FSAR (Duke 2013a).
Source term multiplier	2	To convert single-unit source term to two units.
Site type	Fresh water	Discharge is to the freshwater Broad River.
Reconcentration model	Fully Mixed	Site-specific value from Table 5.4-2 of the ER (Duke 2009a) and Table 11.2-202 of the FSAR (Duke 2013a).
Effluent discharge rate from impoundment system to receiving water body (ft^3/s)	1858	Annual average flow of Broad River over Ninety-Nine Islands Dam (USGS 2010).
Impoundment total volume (ft^3)	1,746,300	The volume of Ninety-Nine Islands Dam forebay (Khan 2007)
Shore width factor	0.2	Suggested value for river shoreline (NRC 1977; Strenge et al. 1986)
Dilution factors for aquatic food and boating, shoreline and swimming, and drinking water	1	Site-specific value from Table 5.4-2 of the ER (Duke 2009a) and Table 11.2-202 of the FSAR (Duke 2013a). The value of "1" indicates complete mixing.
Transit time (hr)	14.2 (drinking water) 0 (all other uses)	Site-specific values from Table 5.4-2 of the ER (Duke 2009a) and Table 11.2-202 of the FSAR (Duke 2013a).
Consumption and usage factors for adults, teens, children, and infants	Shoreline usage (hr/yr) 12 (adult) 67 (teen) 14 (child) 0 (infant) Water usage (L/yr) 730 (adult) 510 (teen) 510 (child) 330 (infant) Fish consumption (kg/yr) 21 (adult) 16 (teen) 6.9 (child) 0 (infant)	LADTAP II code default values (NRC 1977; Strenge et al. 1986).

Table G-1. (contd)

Parameter	NRC Values	Comments
Total 50-mi population	3,455,395	Site-specific value from Table 5.4-2 of the ER (Duke 2009a). Full population data located in Table 2.1-203 and 2.1-204 in Duke's FSAR (Part 2 of the combined license (COL) application) (Duke 2013a). Population distribution used by Duke and the NRC staff was for year 2036. Note that ESRP Section 5.4.1 requires use of "projected population for 5 years from the time of the licensing action under consideration." Assuming the combined license application licensing action occurs in year 2010 and adding 5 years yields year 2015. See discussion of population dose in Section G.1.4.
Population drinking river water	24,725	Site-specific value from the ER (Duke 2009a) and FSAR (Duke 2013a).
Total 50-mi sport fishing (kg/yr)	15,000	Site-specific value from Table 5.4-2 of the ER (Duke 2009a) and FSAR (Duke 2013a).
Total 50-mi shoreline usage (person-hr/yr)	6,620,364	Site-specific value from Table 5.4-2 of the ER (Duke 2009a) and FSAR (Duke 2013a).
Total 50-mi swimming usage (person-hr/yr)	6,620,364	Site-specific value from Table 5.4-2 of the ER (Duke 2009a) and FSAR (Duke 2013a).
Total 50-mi boating usage (person-hr/yr)	6,620,364	Site-specific value from Table 5.4-2 of the ER (Duke 2009a) and FSAR (Duke 2013a).

(a) Only radionuclides included in Regulatory Guide 1.109 are considered (NRC 1977).

Table G-2. Comparison of Doses to the Public from Liquid Effluent Releases for a New Unit

Type of Dose	Duke ER or FSAR[(a)]	NRC Staff Calculation	Percent Difference
Total body (mrem/yr)	0.0609 (adult)	0.0831 (adult)	37
Organ dose (mrem/yr)	0.0775 (child liver)	0.106 (adult GI tract)	37
Thyroid (mrem/yr)	0.0532 (infant)	0.0727 (child)	37
Total body population dose from liquid pathway (person-rem/yr)	0.296	0.404	37

(a) Results from Duke ER Tables 5.4-4 and 5.4-9 (Duke 2009a) or FSAR Tables 11.2-204, 11.2-207 and 11.2-208 (Duke 2013a).

G.2 Dose Estimates to the Public from Gaseous Effluents

The NRC staff used the dose assessment approach specified in Regulatory Guide 1.109 (NRC 1977), and the XOQDOQ and GASPAR II computer code (Sagendorf et al. 1982; Strenge et al. 1987) to estimate doses to the MEI and to the population within an 80-km (50-mi) radius of the Lee Nuclear Station site from the gaseous effluent pathway.

G.2.1 Scope

The NRC staff and Duke calculated the maximum gamma air dose, beta air dose, total body dose, and skin dose from noble gases at the exclusion area boundary (EAB) location (0.81 mi SE of the Lee Nuclear Station site). Dose to the MEI was calculated as the sum of the pathway doses estimated for the locations of the largest pathway doses for the following exposure pathways. The pathways included in the estimates are listed below:

- plume immersion (site boundary at 0.27 mi northwest)
- direct shine from deposited radionuclides (site boundary at 0.27 mi northwest)
- inhalation (site boundary at 0.27 mi northwest)
- ingestion of local farm or garden vegetables (garden 1 mi south-southeast)
- ingestion of locally produced beef (1.65 mi southeast), cow milk (1.65 mi southeast), and goat milk (1.05 mi south-southwest) (Duke 2013a, b).

Since the draft EIS was issued, Duke has revised the gaseous effluent analysis within the COL application (Duke 2013a, b) to (1) adjust the nuclear island footprint (see Section 3.1 of this EIS); (2) incorporate 2 years of meteorological data (years 2007 and 2008); and (3) update the land-use survey data.[a]

The NRC staff reviewed the input parameters and values that Duke (2013a) used for appropriateness, including references made to the AP1000 Design Control Document (Westinghouse 2011). Default values from Regulatory Guide 1.109 (NRC 1977) were used when input parameters were not available. The NRC staff concluded that the assumed

(a) In response to an NRC staff request for additional information (RAI), Duke reevaluated its air dispersion modeling and revised its calculations (Duke 2013b). At the time of publication of this final EIS, the NRC staff review of the applicant's RAI response to assure that the applicant meets all applicable regulatory requirements is ongoing. NRC's evaluation of Duke's response will be addressed in the NRC's Final Safety Evaluation Report and any changes to the COL application that are deemed necessary will be incorporated into the applicant's FSAR.

exposure pathways and input parameters and values used by Duke were appropriate. These pathways and parameters were used by the NRC staff in its independent calculations using GASPAR II.

Joint frequency distribution data of wind speed and wind direction by atmospheric stability class for the Lee Nuclear Station site provided in joint frequency distribution Tables 2.3-235, 2.3-236, 2.3-237, 2.3-238, 2.3-239, 2.3-240, and 2.3-241 of the FSAR (Duke 2013a) were used as input to the XOQDOQ code (Sagendorf et al. 1982) to calculate long-term average χ/Q and D/Q values for routine releases. The NRC staff's independent results confirmed those reported by Duke in Tables 2.3-287 to 2.3-292 of the FSAR (Duke 2013a).

Population doses were calculated for all types of releases (i.e., noble gases, iodine and particulates, and H-3 and C-14) using the GASPAR II code for the following exposure pathways: plume immersion, direct shine from deposited radionuclides, ingestion of vegetables, and ingestion of milk and meat.

G.2.2 Resources Used

To calculate doses to the public from gaseous effluents, the NRC staff used personal computer versions of the XOQDOQ and GASPAR II codes entitled NRCDOSE Version 2.3.13 (Chesapeake Nuclear Services, Inc. 2006) obtained through the Oak Ridge RSICC with updates to the user interface obtained directly from Chesapeake Nuclear Services.

G.2.3 Input Parameters

Table G-3 provides a listing of the major parameters used in calculating dose to the public from gaseous effluent releases during normal operation.

G.2.4 Comparison of Doses to the Public from Gaseous Effluent Releases

The NRC staff compared results documented in the FSAR and request for information responses (Duke 2013a, b) for doses from noble gases at the site boundary and the EAB with the results calculated by the NRC staff. The doses calculated by the NRC staff confirmed the doses calculated by Duke.

The NRC staff compared its estimates of doses to the MEI calculated by Duke. Doses to the MEI estimated by Duke were calculated by summing doses from the maximum locations of each exposure pathway. The doses calculated by the NRC staff confirmed the doses calculated by Duke.

Table G-3. Parameters Used in Calculating Dose to Public from Gaseous Effluent Releases

Parameter	NRC Values		Comments
New unit gaseous effluent source term (Ci/yr)	Ar-41	3.4×10^{1}	Values from Westinghouse AP1000 Design Control Document Table 11.3-3 for a single unit (Westinghouse 2011).
	Kr-85m	3.6×10^{1}	
	Kr-85	4.1×10^{3}	
	Kr-87	1.5×10^{1}	
	Kr-88	4.6×10^{1}	
	Xe-131m	1.8×10^{3}	
	Xe-133m	8.7×10^{1}	
	Xe-133	4.6×10^{3}	
	Xe-135m	7.0×10^{0}	
	Xe-135	3.3×10^{2}	
	Xe-138	6.0×10^{0}	
	I-131	1.2×10^{-1}	
	I-133	4.0×10^{-1}	
	H-3	3.5×10^{2}	
	C-14	7.3×10^{0}	
	Cr-51	6.1×10^{-4}	
	Mn-54	4.3×10^{-4}	
	Co-57	8.2×10^{-6}	
	Co-58	2.3×10^{-2}	
	Co-60	8.7×10^{-3}	
	Fe-59	7.9×10^{-5}	
	Sr-89	3.0×10^{-3}	
	Sr-90	1.2×10^{-3}	
	Zr-95	1.0×10^{-3}	
	Nb-95	2.5×10^{-3}	
	Ru-103	8.0×10^{-5}	
	Ru-106	7.8×10^{-5}	
	Sb-125	6.1×10^{-5}	
	Cs-134	2.3×10^{-3}	
	Cs-136	8.5×10^{-5}	
	Cs-137	3.6×10^{-3}	
	Ba-140	4.2×10^{-4}	
	Ce-141	4.2×10^{-5}	
Population distribution	Table 2.1-203 and Table 2.1-204, of the FSAR (Duke 2013a)		Population distribution used by Duke and the NRC staff was for year 2056. Note that ESRP Section 5.4.1 requires use of "… projected population for 5 years from the time of the licensing action under consideration." Assuming the early site permit licensing action occurs in year 2010 and adding 5 years yields year 2015. See discussion of population dose in Section G.2.5.

Table G-3. (contd)

Parameter	NRC Values	Comments
Atmospheric dispersion factors (sec/m^3)	Tables 2.3-287 to 2.3-291 of the FSAR (Duke 2013a)	Site-specific data provided by Duke for 1-year period from December 2005 through November 2006 (Duke 2013a).
Ground deposition factors (m^{-2})	Table 2.3-292 of the FSAR (Duke 2013a)	Site-specific data provided by Duke for 1-year period from December 2005 through November 2006 (Duke 2013a).
Milk production rate within an 80-km (50-mi) radius of the Lee Nuclear Station site (L/yr)	84,765,807	Site-specific data provided by Duke (Duke 2009a, 2013a).
Vegetable/fruit production rate within an 80-km (50-mi) radius of the Lee Nuclear Station site (kg/yr)	151,333,289	Site-specific data provided by Duke (Duke 2009a, 2013a).
Meat production rate within an 80-km (50-mi) radius of the Lee Nuclear Station site (kg/yr)	354,508,878	Site-specific data provided by Duke (Duke 2009a, 2013a).
Pathway receptor locations (direction, distance, and atmospheric dispersion factors) - nearest site boundary, vegetable garden, residence, meat animal	Table 2.3-286 and Table 2.3-289 of the FSAR (Duke 2013a)	Site-specific data provided by Duke (Duke 2013a).
Consumption factors for milk, meat, leafy vegetables, and vegetables	Milk (L/yr) 310 (adult) 400 (teen) 330 (child) 330 (infant) Meat (kg/yr) 110 (adult) 65 (teen) 41 (child) 0 (infant) Leafy vegetables (kg/yr) 64 (adult) 42 (teen) 26 (child) 0 (infant) Vegetables (kg/yr) 520 (adult) 630 (teen) 520 (child) 0 (infant)	Table 5.4-3 of the ER (Duke 2009a) and Regulatory Guide 1.109 (NRC 1977).

Table G-3. (contd)

Parameter	NRC Values	Comments
Fraction of year leafy vegetables are grown	0.58	Site-specific value from Table 5.4-6 of the ER (Duke 2009b) and Table 11.3-301 of the FSAR (Duke 2013a).
Fraction of year that milk cows are on pasture	0.75	Site-specific value from Table 5.4-6 of the ER (Duke 2009b) and Table 11.3-301 of the FSAR (Duke 2013a).
Fraction of MEI vegetable intake from own garden	0.76	Default value of GASPAR II code (Strenge et al. 1987) and Table 11.3-301 of the FSAR (Duke 2013a).
Fraction of milk-cow intake that is from pasture while on pasture	1	Default value of GASPAR II code (Strenge et al. 1987) and Table 11.3-301 of the FSAR (Duke 2013a).
Average absolute humidity over the growing season (g/m^3)	8.0	Default value of GASPAR II code (Strenge et al. 1987).
Average temperature over the growing season (°F)	None	Default value of GASPAR II code (Strenge et al. 1987).
Fraction of year beef cattle are on pasture	0.75	Site-specific value from Table 5.4-6 of the ER (Duke 2009b) and Table 11.3-301 of the FSAR (Duke 2013a).
Fraction of beef cattle intake from pasture when on pasture	1	Default value of GASPAR II code (Strenge et al. 1987) and Table 11.3-301 of the FSAR (Duke 2013a).
Fraction of year goats are on pasture	0.83	Site-specific value from Table 5.4-6 of the ER (Duke 2009b) and Table 11.3-301 of the FSAR (Duke 2013a).
Fraction of goats' intake that is from pasture while on pasture	1	Default value of GASPAR II code (Strenge et al. 1987) and Table 11.3-301 of the FSAR (Duke 2013a).

G.2.5 Comparison of Results – Population Doses

The NRC staff performed a comparison of the Duke population-dose estimates taken from Table 11.3-204 of the FSAR (Duke 2013a) with the staff estimates for a single new unit. The staff's independent calculation for population dose yielded results that were comparable to the Duke FSAR estimates (Duke 2013a) for a new unit. For calculating the population dose from gaseous effluents, the population distribution used by Duke and the NRC staff was for year 2056. However, ESRP Section 5.4.1 (NRC 2000) requires use of "... projected population for 5 years from the time of the licensing action under consideration." Assuming the COL licensing action occurs in year 2010 and adding 5 years yields year 2015. Because the population is increasing, the use of the Year 2056 is more conservative than required by the rule, and has been used herein. The NRC staff estimates confirmed the estimates by Duke (2013a) to two significant digits.

G.3 Cumulative Dose Estimates

The staff compared Duke's results for cumulative dose estimates to the MEI with those calculated by the NRC staff. Cumulative dose estimates include doses from all pathways (i.e., external, liquid effluent, and gaseous effluent) for the proposed Lee Nuclear Stations Units 1 and 2.

Cumulative doses are based upon the sum of doses from liquid and gaseous releases. As noted above, the NRC staff's estimates of dose from the liquid release pathways are based on a mean average flow rate of the Broad River of 1858 cfs for the water years 2000 to 2010 as measured at the U.S. Geological Survey gage at Ninety-Nine Islands Dam; Duke used a longer-term average of 2538 cfs in its estimates. As a result, the NRC staff's liquid pathway doses are about 37 percent greater than those in Duke's FSAR (Duke 2013a). The cumulative doses are shown in Table G-4. The increase in the liquid pathway doses has only a minimal impact on the total doses because the dominant exposure pathways are related to gaseous releases.

Table G-4. Comparison of Cumulative Doses to the MEI

Dose	Duke (2013a, b)[(a)(b)]	NRC Estimates[(c)]	Percent Difference
Whole body (child, mrem/yr)[(d)]	3.74	3.74	0.0
Thyroid dose (infant, mrem/yr)	20.00	20.00	0.0
Dose to other organ (child bone, mrem/yr)	9.05	9.12	0.8

(a) Doses from direct radiation were determined to be negligible (Duke 2009a).
(b) Sum of doses from liquid and gaseous effluent releases for proposed Lee Nuclear Station Units 1 and 2 from Duke (2013a, b).
(c) The NRC staff calculation included the sum of doses from liquid and gaseous effluent releases from the two proposed units.
(d) The whole body doses were conservatively calculated by summing the maximum individual doses from normal liquid releases (to an adult) and the maximum individual doses from normal gaseous releases (to a child).

G.4 Dose Estimates to the Biota from Liquid and Gaseous Effluents

To estimate doses to the biota from the liquid and gaseous effluent pathways, the NRC staff used the LADTAP II code (Strenge et al. 1986), the GASPAR II code (Strenge et al. 1987), and input parameters supplied by Duke in its ER (Duke 2009a).

G.4.1 Scope

Doses to both terrestrial and aquatic biota were calculated using the LADTAP II code. Aquatic biota includes fish, algae, and invertebrate species. Terrestrial biota includes muskrats, raccoons, herons, and ducks. The LADTAP II code calculates an internal dose component and an external dose component and sums them for a total body dose. The NRC staff reviewed the input parameters used by Duke for appropriateness. Duke estimated doses to biota in the well-mixed flow of the Broad River below the Ninety-Nine Islands Dam outfall. Default values from Regulatory Guide 1.109 (NRC 1977) were used when input parameters were not available. Most of these parameters were used by the NRC staff in its independent calculations using LADTAP II.

The LADTAP II code calculates only biota dose from the liquid effluent pathway. Terrestrial biota could also be exposed via the gaseous effluent pathway. These values would be the same as those for the MEI calculated using the GASPAR II code. Duke (20013b) used the MEI doses at the site boundary (0.27 mi northwest from the proposed Unit 1) to estimate these doses. To account for the greater proximity of the main body mass of animals to the ground compared to humans, Duke's MEI calculation for the biota ground exposures were increased by a ratio of the height at which ground exposure is calculated by GASPAR II (1 m) to the height of the surrogate biota (Duke 2009a). The height of each biota was assumed to be equal to half the length of the animal.

G.4.2 Resources Used

To calculate doses to the biota, the NRC staff used personal computer versions of the LADTAP II and GASPAR II computer codes entitled NRCDOSE Version 2.3.13 (Chesapeake Nuclear Services, Inc. 2006). NRCDOSE was obtained through the Oak Ridge RSICC.

G.4.3 Input Parameters

Most of the LADTAP II input parameters are specified in Section G.1.3 to include the source term, the discharge flow rate to the receiving fresh water system, and the shore width factor. However, the parameters in Section G.1.3 are for regions below the Ninety-Nine Islands Dam spillway, and the NRC staff's biota dose calculations are for the zone in the forebay of the dam just before the spillway. To estimate the concentration of radionuclides in the lake water near the plant outfall diffuser, which will be placed in the forebay, the NRC staff used a 5:1 mixing of the effluent with uncontaminated water. To estimate biota doses from atmospheric releases, the NRC staff used the same assumptions as Duke.

G.4.4 Comparison of Results

Table G-5 compares Duke's biota dose estimates from liquid effluents taken from Table 5.4-17 of the ER (Duke 2009a) with the NRC staff's estimates. The NRC staff's estimates of biota dose via the liquid pathways are larger than Duke's estimates because of the location chosen for the analysis. Doses in the area below the dam are lower than in the small, more-concentrated zone above the forebay of the dam into which the effluent is discharged. For the gaseous pathways, the NRC staff's analysis confirmed Duke's results. The NRC staff's total combined dose estimates of liquid and gaseous pathways are still well below the applicable criteria for evaluation of potential impacts.

Table G-5. Comparison of Dose Estimates to Biota from Liquid Effluents for Two Units

Biota	Duke ER (2009a) (mrad/yr)	NRC Calculations (mrad/yr)
Fish	0.57	22
Muskrat	1.71	64.8
Raccoon	0.67	25.5
Heron	7.82	297
Duck	1.64	62.0
Algae	4.64	180
Invertebrate	1.61	62.1

G.5 Historic and Cultural Resources at the Lee Nuclear Station Site, Make-Up Pond C, and Offsite Developments

Historic and cultural resources at the Lee Nuclear Station site, Make-Up Pond C, and offsite developments are identified in Table G-6 through Table G-13.

Table G-6. Historic and Cultural Resources Identified at the Lee Nuclear Station Site

Site	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO, Tribes Comments
38CK8	Middle -Late Archaic - Woodland lithic/ceramic scatter	Lee Nuclear Station (1900 ac)	Not revisited in 2007, 2009, or 2013	Further investigation warranted (SCIAA 1974); Not eligible (Duke 2009a); Unassessed (Brockington 2009)	South Carolina State Historic Preservation Officer (SHPO) concurs no impacts to historic properties in 1975 (Duke 2009a) and 2012 (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK9	Isolated Archaic lithic	Lee Nuclear Station (1900 ac)	Not revisited in 2007, 2009, or 2013	No further investigation warranted (SCIAA 1974); Not eligible (Duke 2009a)	SHPO concurs no impacts to historic properties in 1975 (Duke 2009a) and 2012 (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK10	Two Isolated Archaic lithics	Onsite direct (750 ac)	Not intact – Disturbed by preparation for the Cherokee Nuclear Station	No further investigation recommended (SCIAA 1974); Not eligible (Duke 2009a)	SHPO concurs no impacts to historic properties in 1975 (Duke 2009a) and 2012 (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK11	Two Isolated Archaic lithics	Onsite direct (750 ac)	Not intact – Disturbed by preparation for the Cherokee Nuclear Station	No further investigation recommended (SCIAA 1974); Not eligible (Duke 2009a)	SHPO concurs no impacts to historic properties in 1975 (Duke 2009a) and 2012 (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK12	19th century homesite	Onsite direct (750 ac)	Not intact – Disturbed by preparation for the Cherokee Nuclear Station	No further investigation recommended (SCIAA 1974); Not eligible (Duke 2009a)	SHPO concurs no impacts to historic properties in 1975 (Duke 2009a) and 2012 (SCDAH 2012a)

Table G-6. (contd)

Site	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
38CK13	Middle Archaic lithic scatter	Onsite direct (750 ac)	Not intact – Disturbed by preparation for the Cherokee Nuclear Station	No further investigation recommended (SCIAA 1974); Not eligible (Duke 2009a)	SHPO concurs no impacts to historic properties in 1975 (Duke 2009a) and 2012 (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK14	Middle Archaic lithic scatter and 19th century - homesite	Onsite direct (spoil area)	No evidence found in 2009 (Brockington 2009)	No further investigation recommended (SCIAA 1974); Unassessed (Brockington 2009), but no evidence found during survey/testing in 2009	SHPO concurs no impacts to historic properties in 1975 (Duke 2009a) and 2012 (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK15	Middle Archaic lithic scatter and 19th century ceramic sherd	Onsite direct (rebar laydown area)	No evidence found in 2009 (Brockington 2009)	No further investigation recommended (SCIAA 1974); Unassessed (Brockington 2009), but no evidence found during survey/testing in 2009	SHPO concurs no impacts to historic properties in 1975 (Duke 2009a) and 2012 (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
Borden's Ferry (38CK16)	Historic ferry over Broad River at County Road 13	Lee Nuclear Station (1900 ac)	Not revisited in 2007, 2009, or 2013	Further investigation; warranted (SCIAA 1974) Not eligible (Duke 2009a)	SHPO concurs no impacts to historic properties in 1975 (Duke 2009a) and 2012 (SCDAH 2012a)
38CK17	19th century homesite	Onsite direct (750 ac)	Not intact - Disturbed by preparation for the Cherokee Nuclear Station	No further investigation recommended (SCIAA 1974); Not eligible (Duke 2009a)	SHPO concurs no impacts to historic properties in 1975 (Duke 2009a) and 2012 (SCDAH 2012a)
38CK18	19th century homesite	Onsite direct (750 ac)	Not intact - Disturbed by preparation for the Cherokee Nuclear Station	No further investigation recommended (SCIAA 1974); Not eligible (Duke 2009a)	SHPO concurs no impacts to historic properties in 1975 (Duke 2009a) and 2012 (SCDAH 2012a)

Table G-6. (contd)

Site	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
Stroup Family Cemetery (38CK19)	Historic cemetery	Onsite direct (wastewater line, grading and spoil areas)	Intact	Further documentation and preservation recommended (SCIAA 1974); Not eligible but protected under State law (Brockington 2007); 50-ft protective buffer recommended (Brockington 2013)	SHPO concurs not eligible but protection warranted (SCDAH 2012a, USACE et al. 2013)
Moss Cemetery (38CK141)	Historic cemetery	Lee Nuclear Station (1900 ac)	Intact	Not eligible but protected under State law (Brockington 2007)	SHPO concurs not eligible but protection warranted (SCDAH 2012a, USACE et al. 2013)
McKown Family Cemetery	Historic cemetery	Onsite direct (grading and spoil areas)	Intact	Not eligible but protected under State law (Brockington 2007); 50-ft protective buffer recommended (Brockington 2013)	SHPO concurs not eligible but protection warranted (SCDAH 2012a, USACE et al. 2013)
Unnamed cemetery	Historic cemetery	Lee Nuclear Station (1900 ac)	Intact	Not eligible but protected under State law (Brockington 2007)	SHPO concurs not eligible but protection warranted (SCDAH 2012a, USACE et al. 2013)
38CK138	Prehistoric lithic scatter and three 19^{th} century glass and ceramic artifacts	Onsite direct (wastewater line)	Intact	Not eligible (Brockington 2009)	SHPO concurs not eligible (SCDAH 2009) and no impacts to historic properties (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK139	19^{th} century homesite or dumpsite	Onsite direct (750 ac)	Intact	Not eligible (Brockington 2009)	SHPO concurs not eligible (SCDAH 2009) and no impacts to historic properties (SCDAH 2012a)
38CK143	19^{th} - 20^{th} century homesite	Onsite direct (spoil area)	Intact	Not eligible (Brockington 2009)	SHPO concurs not eligible (SCDAH 2009) and no impacts to historic properties (SCDAH 2012a)

Table G-6. (contd)

Site	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
38CK185	19^{th} - 20^{th} century homesite	Onsite direct (grading and spoil areas)	Intact	Not eligible (Brockington 2013)	SHPO concurs not eligible (SCDAH 2013)
38CK186	19th century ceramic artifacts	Onsite direct (grading and spoil areas)	Intact	Not eligible (Brockington 2013)	SHPO concurs not eligible (SCDAH 2013)
38CK187	Prehistoric lithic scatter	Onsite direct (grading and spoil areas)	Intact	Not eligible (Brockington 2013)	SHPO concurs not eligible (SCDAH 2013)
38CK188	Middle Archaic lithic scatter	Onsite direct (grading and spoil areas)	Intact	Not eligible (Brockington 2013)	SHPO concurs not eligible (SCDAH 2013)

Table G-7. Historic and Cultural Resources Identified Within Indirect Areas of Potential Effect (APEs) at the Lee Nuclear Station Site

Site	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
Ninety-Nine Islands Dam and Hydro Plant (269-0042)	20th century regional hydropower developments	Onsite indirect (1-mi zone from tallest structures)	Intact	Eligible (Brockington 2007, 2009)	SHPO concurs National Register eligible (SCDAH 2007, 2009) and no adverse effect (SCDAH 2012a)
040-0061 and 040-0061.01	1930s residence (house and shed)	Onsite indirect (1-mi zone from tallest structures)	Intact	Not eligible (Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no impacts to historic properties (SCDAH 2012a)
040-0062	1880s - 1930s residence (Miss Minnie Strap House, relocated from original location)	Onsite indirect (1-mi zone from tallest structures)	Relocated from original location (Brockington 2007)	Not eligible (Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no impacts to historic properties (SCDAH 2012a)
040-0063	1930s residence	Onsite indirect (1-mi zone from tallest structures)	Not intact (ACC 2009:97)	Not eligible (Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no impacts to historic properties (SCDAH 2012a)
040-0064	1940s residence	Onsite indirect (1-mi zone from tallest structures)	Intact	Not eligible (Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no impacts to historic properties (SCDAH 2012a)
040-0065	1940s residence	Onsite indirect (1-mi zone from tallest structures)	Intact	Not eligible (Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no impacts to historic properties (SCDAH 2012a)
040-0066	1940s residence	Onsite indirect (1-mi zone from tallest structures)	Intact	Not eligible (Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no impacts to historic properties (SCDAH 2012a)
040-0067	1940s residence	Onsite indirect (1-mi zone from tallest structures)	Intact	Not eligible (Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no impacts to historic properties (SCDAH 2012a)
McKowns Mountain Baptist Church complex (040-0068)	20th century church, outbuildings, and cemetery	Onsite indirect (1-mi zone from tallest structures)	Intact	Not eligible but cemetery protected under State law (Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no impacts to historic properties (SCDAH 2012a)

Table G-8. Historic and Cultural Resources Identified Within Direct APEs for Make-Up Pond C

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
38CK31	Prehistoric lithic scatter	Make-Up Pond C (spoil area)	No evidence found in 2010 (Brockington 2010)	Unlikely to reveal any important information (SCIAA 1977); Not eligible (Brockington 2010)	SHPO provides no specific comment but concurs with no historic properties affected (SCDAH 2009, 2010, 2012a); Eastern Band Cherokee Indians concur not important (EBCI 2011)
38CK32	Prehistoric lithic scatter	Make-Up Pond C (spoil area)	No evidence found in 2010 (Brockington 2010)	Unlikely to reveal any important information (SCIAA 1977); Not eligible (Brockington 2010)	SHPO provides no specific comment but concurs with no historic properties affected (SCDAH 2009, 2010, 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK58	Prehistoric lithic scatter	Make-Up Pond C (spoil area)	No evidence found in 2010 (Brockington 2010)	Disturbed by modern activities (SCIAA 1981); Not assessed (Brockington 2010)	SHPO provides no specific comment but concurs with no historic properties affected (SCDAH 2009, 2010, 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
Service Family Cemetery 38CK142	Historic cemetery	Make-Up Pond C (borrow pit and reservoir)	Intact	Not eligible but protected under State law (Brockington 2010)	SHPO concurs not eligible but protection warranted (SCDAH 2012a, USACE et al. 2013)
McKown Family Cemetery	Historic cemetery	Make-Up Pond C (water pipeline)	Intact	Not eligible (Brockington 2011) but protected under State law; 50-ft protective buffer recommended (Brockington 2013)	SHPO concurs not eligible but protection warranted (SCDAH 2012a, USACE et al. 2013)
38CK144	19^{th} - 20^{th} century homesite	Make-Up Pond C (reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)

Table G-8 (contd)

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
38CK145	Prehistoric lithic scatter	Make-Up Pond C (reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK146	Middle Archaic lithic scatter and 19th century homesite	Make-Up Pond C (water pipeline)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK147	Middle Archaic lithic scatter	Make-Up Pond C (water pipeline)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK148	19th - 20th century road and bridge	Make-Up Pond C (reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
38CK152	19th - 20th century still	Make-Up Pond C (reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
38CK153	19th - 20th century still	Make-Up Pond C (reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
38CK182	20th century homesite	Make-Up Pond C (spoil area)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
38CK183	20th century homesite	Make-Up Pond C (spoil area)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (2012a)
38CK184	19th - 20th century homesite	Make-Up Pond C (spoil area)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (2012a)

Table G-9. Historic and Cultural Resources Identified Within the Indirect APEs for Make-Up Pond C

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
0072	1920s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0073	1930s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0074	1930s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0075	1930s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0076	1940s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0077 and 0077.01	1930s residence and outbuilding	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0078	1930s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)

Table G-9. (contd)

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
0079	1950s Draytonville Elementary School	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0080	1930s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0081 and 0081.01	1950s Mount Ararat Baptist Church and cemetery	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0082	1910s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0110	1920s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0124	1920s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0125	1940s Hambright Cemetery	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0126	1910s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)

Table G-9. (contd)

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
0127	1920s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0128, 0128.01, 0128.02, 0128.03, 0128.04, and 0128.05	Early 20th century farm buildings	Make-Up Pond C indirect (1.25 mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0129	1940s residence	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0130 and 0130.01	1890s residence and outbuilding	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
0131	1950s barn	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Not eligible (Brockington 2010)	SHPO concurs not eligible (SCDAH 2009, 2010) and no historic properties affected (SCDAH 2012a)
Cherokee Falls Mill and Village (52 resources)	Early 20th century industrial, institutional, and residential buildings	Make-Up Pond C indirect (1.25-mi zone from reservoir)	Intact	Unevaluated (Brockington 2010); Not eligible (SCDAH 2010)	SHPO evaluates not eligible (SCDAH 2009, 2010) and concurs no historic properties affected (SCDAH 2012a)

Table G-10. Historic and Cultural Resources Identified Within Direct and Indirect APEs for the Railroad Corridor

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
38CK38	Prehistoric lithic scatter	Offsite indirect railroad line	Not revisited	Unlikely to reveal any important information (SCIAA 1977)	SHPO no specific comment but concurs with no historic properties affected (SCDAH 2008, 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK68 Ellen Furnace Works	19th century ironworks	Offsite direct railroad line	Intact outside railroad corridor	Eligible – Listed	SHPO concurs National Register eligible (SCDAH 2008) and no adverse effect (SCDAH 2012a)

Table G-11. Historic and Cultural Resources Identified Within Direct APEs For Transmission-Line Routes K and O

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
38CK52	Three isolated Prehistoric lithics	Offsite direct transmission-lines Route K	No evidence found in 2009 (ACC 2009)	Unassessed (ACC 2009)	SHPO provides no specific comment but concurs with no historic properties affected (SCDAH 2009, 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK174	19^{th} - 20^{th} century homesite	Offsite direct transmission-lines Route K	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK175	Prehistoric lithic scatter	Offsite direct transmission-lines Route K	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK176	Prehistoric lithic scatter	Offsite direct transmission-lines Route K	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)

Table G-11. (contd)

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
38CK177	19^{th} - 20^{th} century homesite	Offsite direct transmission-lines Route K	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
38CK178	Prehistoric lithic scatter	Offsite direct transmission-lines Route K	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK179	Prehistoric lithic scatter and 19^{th} century ceramic sherd	Offsite direct transmission-lines Route K	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK180	Prehistoric lithic scatter and 19^{th} century - homesite	Offsite direct transmission-lines Route K	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK181	19^{th} - 20^{th} century homesite	Offsite direct transmission-lines Route K	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
38UN1443	Prehistoric lithic scatter	Offsite direct transmission-lines Route K	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38UN1444	19^{th} - 20^{th} century homesite	Offsite direct transmission-lines Route K	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
38UN1445	Prehistoric lithic scatter	Offsite direct transmission-lines Route K	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38UN1446	Prehistoric lithic scatter	Offsite direct transmission-lines Route K	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)

Table G-11. (contd)

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
38CK149	Mississippian lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK150	Prehistoric lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK151	Prehistoric lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK154	19^{th} - 20^{th} century homesite	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
38CK155	Middle-Late Archaic lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI)
38CK156	Prehistoric lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI)
38CK157	Middle Archaic lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK158	19^{th} - 20^{th} century prospecting pit	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
38CK159	Prehistoric lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)

Table G-11. (contd)

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
38CK160	Middle Archaic lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK161	Prehistoric lithic scatter and 19th - 20th century homesite	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK162	Middle Archaic lithic scatter and 19th - 20th century homesite	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK163	Prehistoric lithic scatter and 19th - 20th century homesite	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK164	Prehistoric lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK165	Prehistoric lithic scatter and 19th - 20th century homesite	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK166	Prehistoric lithic scatter and 19th century ceramic sherd	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK167	Prehistoric lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)

Table G-11. (contd)

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
38CK168	Prehistoric lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK169	Prehistoric lithic scatter and 19th century ceramic sherds	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK170	Prehistoric lithic scatter and 19th century ceramic sherd	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK171	Prehistoric lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38CK172	Possible gravesite	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009) but protected under State law and potentially subject to Federal requirements of NAGPRA	SHPO concurs not eligible (SCDAH 2009) but protection warranted (SCDAH 2012a, USACE et al. 2013); Eastern Band of the Cherokee Indians recommends protection (EBCI 2009)
38CK173	Prehistoric lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38UN1441	Prehistoric lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)
38UN1442	Archaic lithic scatter	Offsite direct transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a); Eastern Band of the Cherokee Indians concurs that the site is not important (EBCI 2011)

Table G-12. Historic and Cultural Resources Identified Within Indirect APEs For Transmission-Line Routes K and O

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
040-0061	1930s residence and outbuilding	Offsite indirect transmission-lines Route K (0.5-mi zone from towers) Onsite indirect (1-mi zone from tallest structures)	Intact	Not eligible (ACC 2009; Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no historic properties affected (SCDAH 2012a)
040-0065	1930s - 1940s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers) Onsite indirect (1-mi zone from tallest structures)	Intact	Not eligible (ACC 2009; Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no historic properties affected (SCDAH 2012a)
040-0066	1930s - 1940s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers) Onsite indirect (1-mi zone from tallest structures)	Intact	Not eligible (ACC 2009; Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no historic properties affected (SCDAH 2012a)
040-0067	1930s - 1940s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers) Onsite indirect (1-mi zone from tallest structures)	Intact	Not eligible (ACC 2009; Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no historic properties affected (SCDAH 2012a)
McKowns Mountain Baptist Church (040-0068)	20th century church, outbuildings, and cemetery	Offsite indirect transmission-lines Route K (0.5-mi zone from towers) Onsite indirect (1-mi zone from tallest structures)	Intact	Not eligible but cemetery protected under State law (ACC 2009; Brockington 2007)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
556-0142	1910s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)

Table G-12. (contd)

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
556-0143	1920s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
556-0144	1930s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
556-0145	1930s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
556-0146	1930s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
556-0147	1940s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
556-0148	1940s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
556-0149	1930s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
556-0154	1940s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
264-0171	1910s residence	Offsite indirect transmission-lines Route K (0.5-mi zone	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH

Table G-12. (contd)

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
		from towers)			2012a)
264-0199	1910s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
264-0200	1900s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Ineligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
264-0241	1900s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
264-0242	1910s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
264-0243	1890s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
264-0244	1920s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
264-1378	1940s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
264-1377	1930s residence	Offsite indirect transmission-lines Route K (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)

Table G-12. (contd)

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
Ninety-Nine Islands Dam and Hydro Plant (269-0042)	20th century regional hydropower development	Offsite indirect transmission-lines Route O (0.5-mi zone from towers) Onsite indirect (1-mi zone from tallest structures)	Intact	Eligible (ACC, Inc. 2009; Brockington 2007, 2009)	SHPO concurs National Register eligible (SCDAH 2007, 2009) and no adverse effect (SCDAH 2012a)
040-0062	1880s - 1930s residence (Miss Minnie Strap House)	Offsite indirect transmission-lines Route O (0.5-mi zone from towers) Onsite indirect (1-mi zone from tallest structures)	Relocated from original location (Brockington 2007)	Not eligible (ACC 2009; Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no historic properties affected (SCDAH 2012aSCDAH 2012a)
040-0063	1900s - 1930s residence	Offsite indirect transmission-lines Route O (0.5-mi zone from towers) Onsite indirect (1-mi zone from tallest structures)	Not Intact	Not eligible (ACC 2009; Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no historic properties affected (SCDAH 2012a)
040-0064	1930s - 1940s residence	Offsite indirect transmission-lines Route O (0.5-mi zone from towers) Onsite indirect (1-mi zone from tallest structures)	Intact	Not eligible (ACC 2009; Brockington 2007)	SHPO concurs not eligible (SCDAH 2007, 2009) and no historic properties affected (SCDAH 2012a)
229-0135	1900s store	Offsite indirect transmission-lines Route O	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)

Table G-12. (contd)

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
229-0136	1900s residence	Offsite indirect transmission-lines Route O (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
229-0137	1940s residence	Offsite indirect transmission-lines Route O (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
556-0139	1900s residence	Offsite indirect transmission-lines Route O (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
229-0141	1900s residence	Offsite indirect transmission-lines Route O (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
229-0150	1900s residence	Offsite indirect transmission-lines Route O (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
229-0151	1900s residence	Offsite indirect transmission-lines Route O (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
040-0152	1910s residence	Offsite indirect transmission-lines Route O (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
269-0153	1900s residence	Offsite indirect transmission-lines Route O (0.5-mi zone from towers)	Intact	Not eligible (ACC 2009)	SHPO concurs not eligible (SCDAH 2009) and no historic properties affected (SCDAH 2012a)
Reid-Walker-Johnson Farm (229-0138 and	Early 20th century farm complex and historic cemetery	Offsite indirect transmission-lines Route O (0.5-mi zone	Intact	Eligible (ACC 2009; Pike Electric 2009)	SHPO concurs National Register eligible (SCDAH 2009, 2010) and no adverse effect (SCDAH

Table G-12. (contd)

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
229-140)		from towers)			2012a)
Smith's Ford Farm (229-1018)	Mid-18th century farm complex	Offsite indirect transmission-lines Route O (0.5-mi zone from towers)	Intact	Eligible (ACC 2009; Pike Electric 2010)	SHPO concurs National Register eligible (SCDAH 2009, 2010) and no adverse effect (SCDAH 2012a)

Table G-13. Historic and Cultural Resources Identified Within Direct APEs For Transportation Improvements

Site #	Site Type	Location (APE)	Status	NRHP Eligibility	SHPO Comment
38CK48	Archaeological site	Offsite direct transportation improvements (SC 329 and McKowns Mountain Road)	No evidence found in 2012	Not eligible (Duke 2012)	SHPO concurs not eligible (SCDAH 2012b)
38CK49	Archaeological site	Offsite direct transportation improvements (SC 329 and McKowns Mountain Road)	No evidence found in 2012	Not eligible (Duke 2012)	SHPO concurs not eligible (SCDAH 2012b)
38CK29	Archaeological site	Offsite direct transportation improvements (SC 329 and US-29)	No evidence found in 2012	Not eligible (Duke 2012)	SHPO concurs not eligible (SCDAH 2012b)
38CK132	Archaeological site	Offsite direct transportation improvements (SC 329 and US-29)	No evidence found in 2012	Not eligible (Duke 2012)	SHPO concurs not eligible (SCDAH 2012b)
38CK133	Archaeological site	Offsite direct transportation improvements (SC 329 and US-29)	No evidence found in 2012	Not eligible (Duke 2012)	SHPO concurs not eligible (SCDAH 2012b)

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Appendix H

Authorizations, Permits, and Certifications

Appendix H

Authorizations, Permits, and Certifications

This appendix contains a list of the environmental-related authorizations, permits, and certifications potentially required by Federal, State, regional, local, and affected Native American Tribal agencies related to the combined construction permit and operating licenses (COLs) for the proposed William States Lee III Nuclear Station (Lee Nuclear Station) Units 1 and 2. Table H-1 is based on Table 1.2-1 of Revision 1 of the environmental report submitted to the U.S. Nuclear Regulatory Commission (NRC) by Duke Energy Carolinas, LLC (Duke 2009), and an update to that table provided in a letter dated March 13, 2013 (Duke 2013).

Table H-1. Federal, State, and Local Environmental Permits and Authorizations

Agency	Authority	Requirement	Activity Covered	Status
Radioactive Materials				
NRC	Title 10 of the *Code of Federal Regulations* (CFR) Part 30	Byproduct license	Approval to receive, possess, and use byproduct material.	To be issued as part of COLs.
NRC	10 CFR Part 40	Source materials license	Approval to receive, possess, and use source material.	To be issued as part of COLs.
NRC	10 CFR Part 52, Subpart Part C	Combined licenses	Construction and operation of two new nuclear units.	Application submitted in December 2007.
NRC	10 CFR Part 70	Special nuclear materials license	Approval to receive, possess, and use special nuclear material.	To be issued as part of COLs.
NRC	10 CFR Part 61	Licensing requirements for land disposal of radioactive wastes	Procedures, criteria, and terms and conditions for the licensing of land disposal facilities intended to contain byproduct, source, and special nuclear materials.	If required.
NRC	10 CFR Part 71	Packaging and transportation of radioactive material	The regulations in this part provide requirements, procedures, and standards for packaging, preparation for shipment, and transportation of licensed material.	If required.
NRC	10 CFR Part 72	Licensing requirements for the independent storage of spent nuclear fuel and high-level radioactive waste	The issuance of licenses to receive, transfer, and possess power reactor spent fuel and other associated radioactive materials in an independent spent fuel storage installation and the terms under which the Commission will issue such a license.	If required.
South Carolina Department of Health and Environmental Control (SCDHEC)	SC R. 61-63	South Carolina radioactive material license	Bringing any radioactive source on the Lee Nuclear Station site.	This license will be received by the contractors owning the radioactive material.

Table H-1. (contd)

Agency	Authority	Requirement	Activity Covered	Status
Air				
SCDHEC	SC R. 61-62	Construction permit (emissions)	Duke-operated permanent air-emitting sources.	Application has not been submitted.
SCDHEC	SC R. 61-62	Title V air operating permit or conditional major source permit	Air emissions operating permit for all operating sources post-construction. Facility-wide emissions will be evaluated for applicability of Title V permit (100 T or greater of any one criteria pollutant) or a conditional major permit. A regulatory analysis with appropriate calculations will be performed to determine whether New Source Review/Prevention of Significant Deterioration is applicable.	Application has not been submitted.
SCDHEC	SC R. 61-62	Title V Construction Air Permit (third-party construction sources)	Third-party contracted stationary fuel-driven engine, concrete batch plant, fuel storage tanks, etc.	Application has not been submitted.
Cherokee County	Fire Marshall	Approval	Open burning for vegetation/right-of-way clearing.	Permit received July 7, 2007.
Groundwater				
SCDHEC	SC R. 61-71	Well permits	Installation and abandonment of wells.	Permits have been received. • Permit 2596 received February 2, 2006. • Permit 2736 received July 3, 2006.
Historic Properties				
South Carolina State Historic Preservation Officer (SHPO) at South Carolina Department of Archives and History Federally recognized American Indian Tribes	36 CFR Part 800	Consultation	Identification and evaluation of historic properties.	Surveys of the Lee Nuclear Station site, the railroad-spur corridor, transmission-line corridors, transportation improvements, and Make-Up Pond C have been completed in coordination with the South Carolina SHPO and interested Tribes and no adverse effects to historic properties have been identified. A Memorandum of Agreement (including a Cultural Resources Management Plan) has been signed by Duke, the USACE, SHPO, and the Catawba Indian Nation (USACE et al. 2013).

Table H-1. (contd)

Agency	Authority	Requirement	Activity Covered	Status
Surface Water				
U.S. Army Corps of Engineers (USACE)	33 CFR 322, 323, 328, and 330	Section 404 dredge and fill permit	Construction of cooling-water intake structure, dredging in pond/river, and construction in waters of the United States.	Application submitted in November 2011 (Duke 2011).
Federal Energy Regulatory Commission (FERC)	18 CFR Part 4	FERC Order for Non-Project Use of Project Lands and Water	Construction of intake and discharge structures in, and water withdrawal and discharge from, Ninety-Nine Islands Reservoir.	Application has not been submitted.
SCDHEC	SC Code, Title 49, Chapter 4 SC R, 61-119	Water withdrawal registration and permit	Water withdrawal from Ninety-Nine Islands Reservoir (Broad River).	Application has not been submitted.
SCDHEC	SC R. 61-9	National Pollutant Discharge Elimination System (NPDES) permit	Discharge of wastewater to surface waters (contractor concrete batch plant, cooling-water blowdown, and process waste discharge).	Application submitted in August 2011. SCDHEC public notice of a draft NPDES permit issued in March 2013 (SCDHEC 2013a). Permit SC0049140 issued July 17, 2013 (SCDHEC 2013b).
SCDHEC	SC R. 61-9 SC R. 72-300	NPDES storm water construction permit	Stormwater to surface-water discharges associated with land disturbance and industrial activity. Requires notice of intent, grading permit, erosion control plan prior to excavation, and Stormwater Pollution Prevention Plan.	Permits received for site activities completed prior to 2013. All activities are now stable and permits have been terminated. Permit applications for future phases will be submitted prior to excavation activities as required by the SCDHEC.
SCDHEC	SC R. 61-67	NPDES permit to construct	Construction of a wastewater treatment plant.	Application has not been submitted.
SCDHEC	Clean Water Act, Section 401, SC R. 61-101	Water quality certification	Federally permitted activities that may result in a discharge to State waters; State certifies water quality standards will not be violated.	Application has not been submitted.
SCDHEC	SC R. 61-58	Permit	Construction and operation of a public water distribution system.	Application has not been submitted.
SCDHEC	SC R. 72-1 to 72-9	Dam repair permit	Required before making repairs to an existing dam.	Permit approved 1/15/2007.
SCDHEC	SC R. 72-1 to 72-9	Dam construction permit	Required to construct dam for Make-Up Pond C.	Application has not been submitted.

Table H-1. (contd)

Agency	Authority	Requirement	Activity Covered	Status
Threatened And Endangered Species				
U.S. Fish and Wildlife Service	Endangered Species Act (50 CFR Parts 13, 17, 222, 226, 227, 402, 424, 450-453)	Consultation	Consultation concerning potential impacts to Federal threatened and endangered species.	Consultation process complete for the Lee Nuclear Station site, railroad-spur corridor, transmission-line corridors, any necessary road work, and Make-Up Pond C.
U.S. Fish and Wildlife Service	Migratory Bird Treaty Act Migratory Bird Treaty Act (50 CFR 10.13, 21)	Consultation	Consultation concerning potential impacts to migratory birds. Federal permit MB000257-0.	Consultation process complete for the Lee Nuclear Station site, railroad-spur corridor, transmission-line corridors, any necessary road work, and Make-Up Pond C.
South Carolina Department of Natural Resources	Nongame and Endangered Species Conservation Act (SC Code, Title 50, Chapter 15, Sections 10-90).	Consultation	Consultation concerning potential impacts to State threatened and endangered wildlife species.	Consultation process is ongoing for the Lee Nuclear Station site, railroad-spur corridor, Make-Up Pond C, and transmission-line corridors.
South Carolina Department of Natural Resources	Nongame and Endangered Species Conservation Act (SC Code, Title 50, Chapter 11, Section 10, and Chapter 9, Section 535).	Consultation	Consultation concerning potential impacts to migratory birds. State permit MD-19-10.	Consultation process complete for the Lee Nuclear Station site, railroad-spur corridor, transmission-line corridors, any necessary road work, and Make-Up Pond C.
South Carolina Department of Natural Resources	South Carolina has no law or regulation for protection of State-ranked plant species	Consultation	Consultation concerning potential impacts to state-ranked plant species.	Consultation process will continue for Make-Up Pond C.
Transportation				
Federal Aviation Administration	Federal Aviation Act, 14 CFR 77	§ 77.15 Permit	Permit for structures over 200 ft. in height (construction cranes, reactor buildings).	Application has not been submitted.
South Carolina Department of Transportation	SC Code Annotated § 57-5-1080	Highway encroachment permit	Building an alternate construction entrance to the Lee Nuclear Station site.	Application has not been submitted.
Waste Management				
SCDHEC	SC R. 61-79 and 61-104	Resource Conservation and Recovery Act (RCRA) ID number	90-day accumulation of hazardous waste.	RCRA generator ID number has been received.

Table H-1. (contd)

Agency	Authority	Requirement	Activity Covered	Status
Miscellaneous				
South Carolina Public Service Commission	SC Code Annotated § 58-33-110	Certificate of Environmental Compatibility and Public Convenience and Necessity	Construction and operation of a generating station of more than 75 megawatts.	Application has not been submitted.
South Carolina Public Service Commission	SC Code Annotated § 58-33-110	Certificate of Environmental Compatibility and Public Convenience and Necessity	Construction and operation of any transmission line with a designed voltage of 125 kV or more.	Application has not been submitted.
South Carolina Fire Marshall Office	Chapter 71, 1976 Code Section 23-36-80, as amended	Blasting permit	Magazine storage and use of high explosives on the Lee Nuclear Station site.	Application has not been submitted.
SCDHEC	SC R. 61-107.11, Part III	Temporary construction and demolition debris permit	Storing of engineered fill. Part III permit-by-rule through notification of the SCDHEC.	Permit received 7/3/2007 as a result of notification to the SCDHEC.
Cherokee County	Building Safety	Building permit	Construction of offices and warehouses only. Buildings subject to inspection.	Application has not been submitted.

H.1 References

Duke Energy Carolinas, LLC (Duke). 2009. *William States Lee III Nuclear Station COL Application, Part 3, Applicant's Environmental Report – Combined License Stage, (Environmental Report*). Revision 1. Charlotte, North Carolina. Accession No. ML090990348.

Duke Energy Carolinas, LLC (Duke). 2011. "William S. Lee III Nuclear Station Joint Application for Activities Affecting Waters of the United States." Submitted by Duke Energy Carolinas, LLC, to United States Army Corps of Engineers. November 2011. Charlotte, North Carolina. Accession Number ML13320A708.

Duke Energy Carolinas, LLC (Duke). 2013. Letter from Christopher Fallon, Duke, to NRC dated March 13, 2013, "Duke Energy Carolinas, LLC, William States Lee III Nuclear Station--Docket Nos. 52-018 and 52-019, AP1000 Combined License Application for the William States Lee III Nuclear Station Units 1 and 2, Supplemental Information Regarding Environmental Review, Ltr#WLG2013.03-01." Accession Number ML13087A299.

South Carolina Department of Health and Environmental Control (SCDHEC). 2013a. *Public Hearing Notice: Proposal to issue new NPDES Permit (Permit# SC0049140)*. March 4, 2013. Columbia, South Carolina.

South Carolina Department of Health and Environmental Control (SCDHEC). 2013b. *Duke Energy Carolina/Lee Nuclear Station Permit Issuance; NPDES Permit: SC0049140 – Department Decision*. July 17, 2013. Columbia, South Carolina.

U.S. Army Corps of Engineers, South Carolina Department of Archives and History State Historic Preservation Office, Catawba Indian Nation, and Duke Energy Carolinas, LLC (USACE, SCSHPO, Catawba, and Duke). 2013. *Cultural Resources Management Plan and Agreement regarding William States Lee III Nuclear Station, Units 1 and 2 and New 230 kV and 525 kV Transmission Lines*. Accession No. ML13213A399.

Appendix I

U.S. Army Corps of Engineers Public Interest Review Factors

Appendix I

U.S. Army Corps of Engineers Public Interest Review Factors

A public interest review must be completed prior to any U.S. Army Corps of Engineers (USACE) permit decision for the proposed William States Lee III Nuclear Station (Lee Nuclear Station) Units 1 and 2 combined construction permits and operating licenses (COLs) project. The emphasis of each public interest review factor (PIRF) (described below) is determined by its importance and relevance to this proposed project. Some PIRFs may warrant greater emphasis, while other PIRFs may not be present or as important based on their relevance. However, full consideration and appropriate emphasis will be given to all comments received by the USACE, including those of Federal, State, and local agencies, and other experts on matters within their expertise. A Department of the Army permit will generally be issued for Federal and Federally authorized activities; another Federal agency's determination to proceed is entitled to substantial consideration in the USACE's public interest review. Mitigation should be developed and incorporated within the public interest review process to the extent that the mitigation is found by the USACE to be reasonable and justified. However, only those measures required to ensure that the project is not contrary to the public interest may be required in this specific context. A Record of Decision prepared for this project will rely on information in this environmental impact statement (EIS) and additional information that will be obtained from Duke's final compensatory mitigation plan when it is sufficiently complete to support a permit decision.

I.1 Conservation

Conservation is the efficient use of resources where that use is significant and/or could significantly affect the availability of the resources for alternative uses. Construction and operation of the proposed Lee Nuclear Station Units 1 and 2 – Duke's proposed project alternative – has been identified as the alternative that has the least impact to the environment and therefore minimizes the adverse effects to conservation of natural resources. The site design avoids and minimizes impacts to waters of the United States to the greatest extent possible given the project purpose. Impacts will occur to 67,285 linear ft of streams, 5.43 ac of wetlands, and 29.63 ac of open water.

I.2 Economics

When private enterprise applies for a permit, it will generally be assumed that appropriate economic evaluations have been completed, the proposal is economically viable, and is needed in the marketplace. However, in appropriate cases, the USACE may conduct an independent review of the need for the project from the perspective of the overall public interest. The economic benefits of many projects are important to the local community and contribute to needed improvements in the local economic base, affecting such factors as employment, tax revenue, community cohesion, community services, and property values. Many projects also contribute to the national economic development (i.e., the increase in the net value of the national output of goods and services).

The proposed project is expected to improve economic conditions in the project area. Increased employment, tax revenues, and business growth should result from construction of the proposed project. During construction, increased jobs and retail activity should combine to provide short-term economic benefits to the region.

I.3 Aesthetics

Construction of the proposed project will create temporary adverse impacts to the aesthetics of the project area. These impacts will be related to vegetation grubbing and clearing, material stockpiling, storage of construction equipment and trailers, forest clear-cutting, and earthmoving activities. The proposed Lee Nuclear Station would be 0.99 mi from the nearest residence, 0.8 mi from the nearest business, and would not be readily visible to motorists from McKowns Mountain Road. As described in Chapter 3, there will be 31.29 mi of transmission-line corridors and 6.8 mi of railroad corridor associated with this project. The transmission lines and railroad corridor would be located in rural areas and would pose long-term minor adverse impacts to residential and agricultural/commercial properties.

I.4 General Environmental Concerns

Reference is made to other sections in this EIS that address concerns regarding wetlands, historic and cultural resources, fish and wildlife resources, and socioeconomic issues. To address and minimize general environmental concerns, project-specific special conditions will be attached to any permit and decision document issued for this project. Specific permit conditions will be included to ensure the project is constructed as designed, and that impacts to the aquatic environment are confined to areas addressed by the permit.

I.5 Wetlands and Waters of the United States

Most wetlands constitute a productive and valuable public resource, the unnecessary alteration or destruction of which should be discouraged as contrary to the public interest. Wetlands considered to perform functions important to the public interest include the following:

- Wetlands that serve significant natural biological functions, including food chain production, general habitat, and nesting, spawning, rearing, and resting sites for aquatic or terrestrial species.
- Wetlands set aside for study of the aquatic environment or as sanctuaries or refuges.
- Wetlands that, if destroyed or altered, would negatively affect natural drainage characteristics, sedimentation patterns, salinity distribution, flushing characteristics, current patterns, or other environmental characteristics.
- Wetlands significant in shielding other areas from wave action, erosion, or storm damage. Such wetlands are often associated with barrier beaches, islands, reefs, and bars.
- Wetlands that serve as valuable storage areas for stormwaters and floodwaters.
- Wetlands that are groundwater discharge areas and maintain minimum base flows important to aquatic resources and those that are prime natural recharge areas.
- Wetlands that serve significant water purification functions.
- Wetlands unique in nature or scarce in quantity to the region or local area.

Although a particular alteration of a wetland may constitute a minor change, the cumulative effect of numerous piecemeal changes can result in a major impairment of wetland resources. Thus, one or more particular wetland sites for which an application is made are evaluated with the recognition that they may be part of a complete and interrelated wetland area.

The proposed project will impact 5.43 ac of wetlands, 67,285 linear ft of tributaries, and 29.63 ac of open water, including all project area components. As described in Chapter 4, these impacts will be the combined result of fill placement, excavation, inundation, and conversion from forested to non-forested condition, and thus will involve permanent losses and temporary changes in wetland and stream functions. Proposed wetland and stream compensatory mitigation (Section 4.3.1.7) would be included in any Department of the Army permit decision and, on this basis, would be expected to offset these losses.

I.6 Fish and Wildlife Values

In accordance with the Fish and Wildlife Coordination Act, the USACE must consult with the Regional Director of the U.S. Fish and Wildlife Service (FWS), the Regional Director of the National Marine Fisheries Service (NMFS), and the Director of the South Carolina Department of Natural Resources (SCDNR) regarding the conservation of fish and wildlife resources by preventing their direct and indirect loss due to a proposed project. The USACE will give full consideration to the views of those agencies on fish and wildlife matters in deciding on the issuance, denial, or conditioning of individual or general Department of the Army permits.

By letter dated March 6, 2012 (FWS 2012), the FWS indicated concurrence with the USACE determination that the proposed project is not likely to adversely affect Federally protected species within the proposed transmission-line corridors, the railroad corridor, Make-Up Pond C, or the Lee Nuclear Station, and that the project will not result in the adverse modification of proposed or designated critical habitat.

By letter dated March 6, 2012 (NMFS 2012), the NMFS indicated their concurrence that the project will have no effect on essential fish habitat or Federally managed fishery species, and offered no recommendations under the Magnuson-Stevens Fishery Conservation and Management Act.

By letters dated March 6, 2012 (SCDNR 2012a), and October 23, 2012 (SCDNR 2012b), the SCDNR offered recommendations for revisions to proposed construction methods, property management for wildlife benefit, and mitigation design with the intent of minimizing the project's overall effects on fish and wildlife. These recommendations will be considered by the USACE as the project design becomes final and in any Department of the Army permit decision.

I.7 Historic, Cultural, Scenic, and Recreational Values

Applications for Department of the Army permits may involve areas that possess recognized historic, cultural, scenic, conservation, recreational, or similar values. In such cases, full evaluation of the general public interest requires that due consideration be given to the effect that the proposed structure or activity may have on historic, cultural, scenic, and recreational values. Such values include those associated with wild and scenic rivers, historic properties and National Landmarks, National Rivers, National Wilderness Areas, National Seashores, National Recreation Areas, National Lakeshores, National Parks, National Monuments, estuarine and marine sanctuaries, archaeological resources, including Indian religious or cultural sites, and such other areas as may be established under Federal or State law for similar and related purposes. Recognition of these values often is reflected by State, regional, or local land-use classifications, or by similar Federal controls or policies. Decisions based on permit applications should, to the extent possible, be consistent with and avoid significant adverse effects on the values or purposes for which the classifications, controls, or policies were established.

By letter dated January 20, 2012 (SCDAH 2012), the State Historic Preservation Office (SHPO) provided their opinion that the proposed project will have "no adverse effect" on any known historic or archaeological resources; however, archaeological sites and historic cemeteries fall within the project boundary. The “no adverse effect” determination is conditioned upon Duke adhering to the protective measures detailed in a Cultural Resource Management Plan and Memorandum of Agreement executed on January 9, 2013, among Duke, the SHPO, the Catawba Indian Nation, and the USACE (USACE et al. 2013).

I.8 Floodplains and Flood Hazards

Floodplains possess significant natural values and carry out numerous functions important to the public interest. These include (1) water resources values (natural moderation of flooding, water-quality maintenance, and groundwater recharge), (2) living resource values (fish, wildlife, and plant resources), (3) cultural resource values (open space, natural beauty, scientific study, outdoor education, and recreation), and (4) cultivated resource values (agriculture, aquaculture, and forestry). Although a particular alteration to a floodplain may constitute a minor change, the cumulative impact of such changes may result in a significant degradation of floodplain values and functions and in increased potential for harm to upstream and downstream activities. In accordance with the requirements of Executive Order 11988 (42 FR 26951), the USACE, as part of its public interest review, should avoid, to the extent practicable, long- and short-term significant adverse impacts associated with the occupancy and modification of floodplains, as well as the direct and indirect support of floodplain development whenever there is a practicable alternative. For those activities that, in the public interest, must occur in or impact upon floodplains, the USACE will verify, to the maximum extent practicable, that the impacts of potential flooding on human health, safety, and welfare are minimized, the risks of flood losses are minimized, and whenever practicable, the natural and beneficial values served by floodplains are restored and preserved. In accordance with Executive Order 11988, the USACE avoids authorizing floodplain developments whenever practicable alternatives exist outside the floodplain. If there are no such practicable alternatives, the USACE considers, as a means of mitigation, alternatives within the floodplain that will lessen any significant adverse impact on the floodplain.

A floodplain evaluation was conducted in accordance with Executive Order 11988 “Floodplain Management.” Building activities for the cooling-water intake structure and discharge structure would be located within the Broad River floodplain and would comply with all applicable regulatory requirements under the Clean Water Act (CWA). Specifically, however, the proposed project will not involve placement of fill material into the 100-year floodplain to construct the water intake and discharge structures and, thus, will not affect 100-year floodplain elevations. While approximately 66 ac of transmission-line corridors are within the 100-year floodplain, construction of transmission lines will not require placement of fill material and, thus, will not affect the 100-year floodplain. The embankment dam for Make-Up Pond C will be located within the 100-year floodplain for the Broad River and would require placement of fill material within that area for its construction. There is no regulated floodway within the proposed project area; therefore, no encroachments or modifications to such a floodway would occur. The proposed project is not expected to contribute to conditions that would either increase or decrease flooding within the project area. Impervious areas will route storm water to treatment areas designed to provide adequate storage volumes as required by Section 402 of the CWA. Structures to be placed within the open waters of the Ninety Nine Islands Reservoir (Broad River) will result in negligible displacement of water volume storage and will have no effect on flood hazards.

I.9 Land Use

The proposed project area is approximately 5129 ac in size (the Lee Nuclear Station site encompasses 1885 ac, Make-Up Pond C encompasses 2116 ac, transmission-line corridors encompass 987 ac, the railroad corridor encompasses 41.2 ac; see Section 2.4.1). The Lee Nuclear Station site is the site of the previously proposed Cherokee Nuclear Station and, as such, was cleared prior to submittal of Duke's application for a Department of the Army permit. As discussed in Chapter 2, the direct effects of the project would not substantially change land uses, except for construction of Make-Up Pond C, which will permanently inundate approximately 620 ac of forest and pasture land. The proposed transmission lines would have a total length of 31.29 mi and, except for permanent forest clearing within the corridors, would not appreciably change surrounding land uses or influence future growth and development. Transmission-line corridors traverse primarily rural lands that are forested or cleared for agriculture/grazing. The proposed railroad corridor exists, although it must be rehabilitated and 1300 ft of it must be re-routed for rail use. These land uses will not change because of the proposed project.

I.10 Navigation

Section 11 of the Rivers and Harbors and Appropriations Act of 1899 authorized establishment of harbor lines shoreward of which no individual permits were required. Because harbor lines were established on the basis of navigation impacts only, the USACE published a regulation on May 27, 1970 (33 CFR 209.150), which declared that permits would thereafter be required for activities shoreward of the harbor lines. Review of applications is based on a full public interest evaluation, and harbor lines would serve as guidance for assessing navigation impacts. Accordingly, activities constructed shoreward of harbor lines prior to May 27, 1970, do not require specific authorization. Protection of navigation in all navigable waters of the United States continues to be a primary concern of the Federal government.

I.11 Intake and Discharge Structures

While not Rivers and Harbors Act Section 10 waters, the Ninety Nine Islands Reservoir (Broad River) is accessible to boaters in small craft. Intake and discharge structures proposed for placement in Ninety Nine Islands Reservoir have been designed to be located near the shoreline and away from portions of the reservoir and/or channels where navigation would be most likely. These structures will be well-marked, large-diameter piping that is clearly visible above the water line and should not pose any hazards to watercraft.

I.12 Shore Erosion and Accretion

There are no tidally influenced shorelines involved with this project. Work associated with intake and discharge structures to be placed in Ninety Nine Islands Reservoir (Broad River) is not expected to result in any conditions that would increase or decrease shore erosion or accretion. Impacts related to shore erosion and accretion will be negligible.

I.13 Recreation

No parks or recreational facilities within the project area will be impacted by the proposed project. In addition, the Lee Nuclear Station site would be access-controlled by trained security at all times as required by U.S. Department of Homeland Security regulations.

I.14 Water Supply and Conservation

Water is an essential resource, basic to human survival, economic growth, and the natural environment. Water conservation requires the efficient use of water resources in all actions that involve the significant use of water or that significantly affect the availability of water for alternative uses, including opportunities to reduce demand and improve efficiency to minimize new supply requirements. Actions affecting water quantity are subject to Congressional policy as stated in Section 101(g) of the CWA, which authorizes States to allocate water quantities in a way that shall not be superseded, abrogated, or otherwise impaired. This project will affect surface or groundwater supplies by consumptive use for reactor cooling and other operational uses. Based on information detailed in Chapters 4 and 5 regarding surface and groundwater use and quality, the USACE expects that this project will result in long-term adverse but minimal impacts to water supply.

I.15 Water Quality

Project activities that may adversely affect the quality of waters of the United States will be evaluated for compliance with applicable effluent limitations and water-quality standards, during the construction and subsequent operation of the proposed activity, and will consider both point and non-point sources of pollution. It should be noted, however, that the CWA assigns responsibility for control of non-point sources of pollution to the States. Certification of compliance with applicable effluent limitations and water-quality standards required under provisions of Section 401 of the CWA will be considered conclusive with respect to water-quality considerations unless the Regional Administrator of the U.S. Environmental Protection Agency (EPA) advises that other water-quality aspects be taken into consideration.

Duke's construction activities may have temporary impacts on water quality in areas of active work. Impacts will be minimized through appropriate use of Best Management Practices, including appropriate placement and use of erosion and sedimentation control measures which will be required as special conditions of any Department of the Army permit decision proposed in Duke's Stormwater Pollution Prevention Plan. It is expected that there will be no appreciable negative effect on water quality provided Duke complies with conditions typically included in a Water Quality Certification issued by South Carolina Department of Health and Environmental Control and referenced by conditions included in any forthcoming Department of the Army permit.

I.16 Energy Needs

This project is to provide additional baseload electric generating capacity by a public utility provider for its service area. Construction activities for the proposed project will use energy resources. Although construction activities will require an initial consumption of energy that would not otherwise be used if the project were not undertaken, completion of the entire project will provide an estimated full capacity of 2234 MW(e).

I.17 Safety

As a PIRF, safety is most closely reviewed in association with impoundment structures. To ensure that all impoundment structures are designed for safety, Duke will be required to demonstrate that the structures comply with established State dam safety criteria or have been designed by qualified persons and that the design has been independently reviewed (and modified as the review would indicate) by similarly qualified persons. This project is not expected to result in significant safety concerns. A full nuclear safety review of the proposed project will be completed by the U.S. Nuclear Regulatory Commission (NRC). The NRC's safety review will be documented in a Safety Evaluation Report to support its Record of Decision, under the provisions of 10 CFR Part 52, whether or not to issue COLs to Duke authorizing construction and operation of the proposed Lee Nuclear Station Units 1 and 2.

I.18 Food and Fiber Production

The proposed project is not expected to have any noticeable effect on the production of food and fiber. The proposed transmission-line corridors will traverse some grassland/pasture (see Section 2.2.3.1). These areas will remain suitable as grassland/pasture. The USACE has concluded that project-related impacts to food and fiber production will be negligible.

I.19 Mineral Needs

Not applicable.

I.20 Consideration of Property Ownership

Authorization of work or structures by the USACE neither conveys a property right nor authorizes any injury to property or invasion of other rights. An inherent aspect of property ownership is a right to reasonable private use. However, this right is subject to the rights and interests of the public in the navigable and other waters of the United States, including the Federal navigation servitude and Federal regulation for environmental protection. Because a landowner has the general right to protect property from erosion, applications to erect protective structures will usually receive favorable consideration. However, if the protective structure may cause damage to the property of others, adversely affect public health and safety, adversely affect floodplain or wetland values, or otherwise appears contrary to the public interest, the USACE will advise the applicant and inform them of possible alternative methods of protecting the property. Any USACE permit decision will not require the displacement of any residences or businesses. Considerations of property ownership are not applicable.

I.21 References

10 CFR Part 52. *Code of Federal Regulations*, Title 10, *Energy*, Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants.”

33 CFR Part 209. *Code of Federal Regulations*. Title 33, *Navigation and Navigable Waters,* Part 209, “Administrative Procedure.”

42 FR 26951. May 24, 1977. “Executive Order 11988 of May 24, 1977, Floodplain Management.” Office of the President.

Clean Water Act. 33 U.S.C. 1251 et seq. (also referred to as the Federal Water Pollution Control Act [FWPCA]).

Fish and Wildlife Coordination Act. 16 U.S.C. 661-667(e) et seq.

U.S. Fish and Wildlife Service (FWS). 2012. Letter from Jay B. Herrington, Field Supervisor to Lt. Col. Edward P. Chamberlayne, USACE Charleston District Commander. Dated March 6, 2012. FWS Log No. 2012-CPA-0036.

National Marine Fisheries Service (NMFS). 2012. Letter from Virginia M. Fay, Assistant Regional Administrator, Habitat Conservation Division to Lt. Col. Edward P. Chamberlayne, USACE dated March 6, 2012. Charleston District Commander.

Rivers and Harbors Appropriation Act of 1899, 33 U.S.C. 403, as amended (also referred to as the Rivers and Harbors Act of 1899).

South Carolina Department of Archives and History (SCDAH). 2012. Letter from Rebekah Dobrasko, SCDAH, to Cindy Blady, NRC, dated January 20, 2012, "William States Lee III Nuclear Station Units 1 and 2, Draft Environmental Impact Statement, Cherokee County, South Carolina, SHPO No. 06-RD163." Accession No. ML12048A671.

South Carolina Department of Natural Resources (SCDNR). 2012a. Letter from Bob Perry, Director Office of Environmental Resources to Dr. Richard Darden, USACE, and Ms. Alicia Rowe, South Carolina Department of Health and Environmental Control, dated March 6, 2012. Bureau of Water.

South Carolina Department of Natural Resources (SCDNR). 2012b. Letter from Bob Perry, Director Office of Environmental Resources, to Ms. Alicia Rowe dated October 23, 2012, South Carolina Department of Health and Environmental Control, Bureau of Water.

U.S. Army Corps of Engineers, South Carolina Department of Archives and History State Historic Preservation Office, Catawba Indian Nation, and Duke Energy Carolinas, LLC. 2013. *Cultural Resources Management Plan and Agreement regarding William States Lee III Nuclear Station, Units 1 and 2 and New 230 kV and 525 kV Transmission Lines*. Accession No. ML13213A399.

Appendix J

Carbon Dioxide Footprint Estimates for a 1000-MW(e) Reference Reactor

Appendix J

Carbon Dioxide Footprint Estimates for a 1000-MW(e) Reference Reactor

The review team has estimated the carbon dioxide (CO_2) footprint of various activities associated with nuclear power plants. These activities include building, operating, and decommissioning the plant. The estimates include direct emissions from the nuclear facility and indirect emissions from workforce transportation and the uranium fuel cycle.

Construction equipment estimates listed in Table J-1 are based on hours of equipment use estimated for a single nuclear power plant at a site requiring a moderate amount of terrain modification. Equipment usage for a multiple unit facility would be larger, but it is likely that it would not be a factor of 2 or larger. A reasonable set of emissions factors used to convert the hours of equipment use to CO_2 emissions are based on carbon monoxide (CO) emissions (UniStar 2007) scaled to CO_2 using a scaling factor of 165 tons of CO_2 per ton of CO. This scaling factor is based on emissions factors in Table 3.3-1 of AP-42 (EPA 1995). Equipment emissions estimates for decommissioning are one-half of those for construction.

Table J-1. Construction Equipment CO_2 Emissions (metric tons equivalent)

Equipment	Construction Total[a]	Decommissioning Total[b]
Earthwork and dewatering	1.1×10^4	5.4×10^3
Batch plant operations	3.3×10^3	1.6×10^3
Concrete	4.0×10^3	2.0×10^3
Lifting and rigging	5.4×10^3	2.7×10^3
Shop fabrication	9.2×10^2	4.6×10^2
Warehouse operations	1.4×10^3	6.8×10^2
Equipment maintenance	9.6×10^3	4.8×10^3
TOTAL[c]	$\mathbf{3.5 \times 10^4}$	$\mathbf{1.8 \times 10^4}$

(a) Based on hours of equipment usage over 7-yr period.
(b) Based on equipment usage over 10-yr period.
(c) Total not equal to the sum due to rounding.

Workforce estimates are typical workforce numbers for new plant construction and operation based on estimates in various combined license (COL) applications, and decommissioning workforce emissions estimates are based on decommissioning workforce estimates in the *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1 Regarding the Decommissioning of Nuclear Power Reactors* (NRC 2002). A typical construction workforce averages about 2500 for a 7-year period with a peak workforce of about 4000. A typical operations workforce for the 40-year life of the plant is assumed to be about 400, and the decommissioning workforce during a decontamination and dismantling period of 10 years is assumed to be 200 to 400. In all cases, the daily commute is assumed to involve a 100-mi roundtrip with two individuals per vehicle. Considering shifts, holidays, and vacations, 1250 roundtrips per day are assumed each day of the year during construction, 200 roundtrips per day are assumed each day during operations, and 150 roundtrips per day are assumed 250 days per year for the decontamination and dismantling portion of decommissioning. If the SAFSTOR decommissioning option is included in decommissioning, 20 roundtrips each day of the year are assumed for the caretaker workforce.

Table J-2 lists the review team's estimates of the CO_2 equivalent emissions associated with workforce transport. The table lists the assumptions used to estimate total miles traveled by each workforce and the factors used to convert total miles to metric tons CO_2 equivalent. CO_2 equivalent accounts for other greenhouse gases, such as methane and nitrous oxide, that are emitted by internal combustion engines. The workers are assumed to travel in gasoline-powered passenger vehicles (e.g., cars, trucks, and vans) that consume an average of 19.7 mi/gal (FHWA 2006). Conversion from gallons of gasoline burned to CO_2 equivalent is based on U.S. Environmental Protection Agency (EPA) emissions factors (EPA 2007a, b).

Table J-2. Workforce CO_2 Footprint Estimates

	Construction Workforce	**Operational Workforce**	**Decommissioning Workforce**	**SAFSTOR Workforce**
Roundtrips per day	1250	200	150	20
Miles per roundtrip	100	100	100	100
Days per year	365	365	250	365
Years	7	40	10	40
Miles traveled	3.2×10^8	2.9×10^8	3.8×10^7	2.92×10^7
Miles per gallon[a]	19.7	19.7	19.7	19.7
Gallons fuel burned	1.6×10^7	1.5×10^7	1.9×10^6	1.58×10^6
Metric tons CO_2 per gallon[b]	8.81×10^{-3}	8.81×10^{-3}	8.81×10^{-3}	8.81×10^{-3}
Metric tons CO_2	1.4×10^5	1.3×10^5	1.7×10^4	1.3×10^4
CO_2 equivalent factor[c]	0.971	0.971	0.971	0.971
Metric tons CO_2 equivalent	1.5×10^5	1.3×10^5	1.7×10^4	1.3×10^4

(a) FHWA 2006
(b) EPA 2007b
(c) EPA 2007a

Published estimates of uranium fuel cycle CO_2 emissions required to support a nuclear power plant range from about 1 percent to about 5 percent of the CO_2 emissions from a comparably sized coal-fired plant (Sovacool 2008). A coal-fired power plant emits about 1 metric ton of CO_2 for each megawatt hour generated (Miller and Van Atten 2004). Therefore, for consistency with Table S–3 of Title 10 of the *Code of Federal Regulations* (CFR) Part 51.51, the NRC staff estimated the uranium fuel cycle CO_2 emissions as 0.05 metric ton of CO_2 per MWh generated and assumed a 80 percent capacity factor. Finally, the review team estimated the CO_2 emissions directly related to plant operations from the typical usage of various diesel generators on site using EPA emissions factors (EPA 1995). The review team assumed an average of 600 hours of emergency diesel generator operation per year (total for four generators) and 200 hours of station blackout diesel generator operation (total for two generators).

Given the various sources of CO_2 emissions discussed above, the review team estimates the total life CO_2 footprint for a reference 1000-MW(e) nuclear power plant to be about 18,000,000 metric tons. The components of the footprint are summarized in Table J-3. The uranium fuel cycle component of the footprint dominates all other components. It is directly related to power generated. As a result, it is reasonable to use reactor power to scale the footprint to larger reactors.

Table J-3. Reference Reactor Lifetime CO_2 Footprint

Source	Activity Duration (yr)	Total Emissions (metric tons)
Construction equipment	7	3.5×10^4
Construction workforce	7	1.5×10^5
Plant operations	40	1.9×10^5
Operations workforce	40	1.3×10^5
Uranium fuel cycle	40	1.7×10^7
Decommissioning equipment	10	1.8×10^4
Decommissioning workforce	10	1.7×10^4
SAFSTOR workforce	40	1.3×10^4
TOTAL		$\mathbf{1.8 \times 10^7}$

In closing, the review team considers the footprint estimated in Table J-3 to be appropriately conservative. The CO_2 emissions estimates for the dominant component (uranium fuel cycle) are based on 30-year-old enrichment technology, assuming that the energy required for enrichment is provided by coal-fired generation. Different assumptions related to the source of energy used for enrichment or the enrichment technology that would be just as reasonable could lead to a significantly reduced footprint.

Emissions estimates presented in the body of this environmental impact statement have been scaled to values that are appropriate for the proposed project. The uranium fuel cycle emissions have been scaled by reactor power using the scaling factor determined in Chapter 6 of this environmental impact statement and by the number of reactors to be built. For the proposed William States Lee III Nuclear Station, the scaling factor is 2.68 rounded to 3 for added conservatism, and two AP1000 reactors are proposed to be built. Plant operations emissions have been adjusted to represent the number of large CO_2 emissions sources (e.g., diesel generators, boilers, etc.) associated with the project. The workforce emissions estimates have been scaled to account for differences in workforce numbers and commuting distance. Finally, equipment emissions estimates have been scaled by estimated equipment usage. As shown in Table J-3, only the scaling of the uranium fuel cycle emissions estimates makes a significant difference in the total carbon footprint of the project.

For comparison, Sovacool (2008) also calculated emission factors during the life cycle of nuclear power plants based on the statistical analysis from 19 qualified studies examined. Estimated emission factors ranged from 1.4 g CO_2-equivalent per kWh to 288 g CO_2-equivalent per kWh, with a mean value of 66 g CO_2-equivalent per kWh (equivalent to 0.066 MT of CO_2-equivalent per kWh). The emission factor of 0.05 MT of CO_2 per MWh used in this analysis is about three-fourths the mean emission factor of 0.066 MT of CO_2-equivalent per MWh, but is considered comparable, considering the wide range of emission factors (0.0014 to 0.288) estimated in that study.

J.1 References

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10. SUPPLEMENTARY NOTES

11. ABSTRACT (200 words or less)

This environmental impact statement (EIS) has been prepared in response to an application submitted to the U.S. NRC by Duke Energy Carolinas, LLC (Duke) for two combined construction permits and operating licenses (combined licenses or COLs). The proposed actions requested in Duke's application are (1) NRC issuance of COLs for two nuclear power reactors at the William States Lee III Nuclear Station (Lee Nuclear Station) site in Cherokee County, South Carolina, and (2) U.S. Army Corps of Engineers (USACE) permit action on a Department of the Army individual permit application to perform certain construction activities on the site. The USACE is participating with the NRC in preparing this EIS as a cooperating agency and participates collaboratively on the review team.

This EIS includes the review team's analysis that considers and weighs the environmental impacts of building and operating two new nuclear units at the proposed Lee Nuclear Station site and at alternative sites, and mitigation measures available for reducing or avoiding adverse impacts. The EIS includes the evaluation of the proposed project's impacts on waters of the United States pursuant to Section 404 of the Clean Water Act.

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