CHAPTER 6
ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS
PLANT DESCRIPTION

TABLE OF CONTENTS

Section	Title	Page
6.0	ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS	6-1
6.1	THERMAL MONITORING	6-3
6.1.1	PRE-APPLICATION THERMAL MONITORING	6-4
6.1.1.1	Freshwater Streams	6-4
6.1.1.2	Lakes and Impoundments	6-5
6.1.2	PRE-OPERATIONAL THERMAL MONITORING	6-6
6.1.3	OPERATIONAL THERMAL MONITORING	6-7
6.1.4	REFERENCES	6-8
6.2	RADIOLOGICAL MONITORING	6-11
6.2.1	PROPOSED RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM	6-11
6.2.2	SAMPLE AND CONTROL LOCATIONS	6-13
6.2.3	SAMPLE ANALYSIS	6-14
6.2.3.1	Lower Limit of Detection for Sample Analyses	6-14
6.2.3.2	Direct Radiation Monitoring	6-14
6.2.3.3	Air Monitoring	6-15
6.2.3.4	Aquatic Monitoring	6-15
6.2.3.5	Terrestrial Monitoring	6-16
6.2.3.6	Water Monitoring	6-17
6.2.4	QUALITY ASSURANCE PROGRAM	6-18
6.2.5	REFERENCES	6-19
6.3	HYDROLOGICAL MONITORING	6-25
6.3.1	PRE-APPLICATION HYDROLOGICAL MONITORING PROGRAM	6-26
6.3.1.1	Freshwater Streams	6-26
6.3.1.2	Lakes and Impoundments	6-27
6.3.1.3	Groundwater	6-27
6.3.2	CONSTRUCTION HYDROLOGICAL MONITORING PROGRAM	6-28
6.3.2.1	Freshwater Streams	6-28

TABLE OF CONTENTS (CONTINUED)

Section	Title	Page
6.3.2.2	Lakes and Impoundments	6-29
6.3.2.3	Groundwater	6-29
6.3.3	PRE-OPERATIONAL HYDROLOGICAL MONITORING PROGRAM	6-30
6.3.3.1	Freshwater Streams	6-30
6.3.3.2	Lakes and Impoundments	6-30
6.3.3.3	Groundwater	6-30
6.3.4	OPERATIONAL HYDROLOGICAL MONITORING PROGRAM	6-31
6.3.4.1	Freshwater Streams	6-31
6.3.4.2	Lakes and Impoundments	6-31
6.3.4.3	Groundwater	6-31
6.3.5	REFERENCES	6-32
6.4	METEOROLOGICAL MONITORING	6-33
6.4.1	GENERAL DESCRIPTION — ON-SITE METEOROLOGICAL MONITORING PROGRAM	6-33
6.4.2	INSTRUMENTATION — 1973 TO CURRENT PERIOD OF OPERATION	6-33
6.4.2.1	Wind Systems	6-34
6.4.2.2	Temperature Systems	6-34
6.4.2.3	Precipitation and Solar Radiation Systems	6-34
6.4.2.4	Maintenance and Calibration	6-35
6.4.2.5	Data Reduction	6-35
6.4.2.6	Accuracy of Measurements	6-36
6.4.3	REFERENCES	6-36
6.5	ECOLOGICAL MONITORING	6-40
6.5.1	TERRESTRIAL ECOLOGY	6-41
6.5.1.1	Pre-Application Terrestrial Monitoring	6-42
6.5.1.2	Site Preparation and Construction Monitoring	6-49
6.5.1.3	Pre-Operational Terrestrial Monitoring	6-54
6.5.1.4	Operational Terrestrial Monitoring	6-55
6.5.2	AQUATIC ECOSYSTEM	6-57
6.5.2.1	Pre-Application Monitoring	6-58
6.5.2.2	Site Preparation and Construction Monitoring	6-63
6.5.2.3	Pre-Operational Monitoring	6-66
6.5.2.4	Operational Monitoring	6-67
6.5.3	REFERENCES	6-68

TABLE OF CONTENTS (CONTINUED)

Section	Title	Page
6.6	CHEMICAL MONITORING	6-79
6.6.1	PRE-APPLICATION CHEMICAL MONITORING	6-79
6.6.1.1	Freshwater Streams	6-80
6.6.1.2	Lakes and Impoundments	6-81
6.6.1.3	Groundwater	6-82
6.6.2	CONSTRUCTION AND PRE-OPERATIONAL CHEMICAL MONITORING	6-83
6.6.2.1	Freshwater Streams	6-83
6.6.2.2	Lakes and Impoundments	6-83
6.6.2.3	Groundwater	6-84
6.6.3	OPERATIONAL CHEMICAL MONITORING	6-84
6.6.3.1	Freshwater Streams	6-85
6.6.3.2	Lakes and Impoundments	6-85
6.6.3.3	Groundwater	6-85
6.6.4	REFERENCES	6-86
6.7	SUMMARY OF MONITORING PROGRAMS	6-90
6.7.1	THERMAL MONITORING	6-90
6.7.1.1	Pre-Application Monitoring Program	6-90
6.7.1.2	Pre-Operational Monitoring Program	6-90
6.7.1.3	Operational Monitoring Program	6-90
6.7.2	RADIOLOGICAL MONITORING	6-91
6.7.2.1	Pre-Operational Monitoring Program	6-91
6.7.2.2	Operational Monitoring Program	6-91
6.7.2.3	Quality Assurance Program	6-93
6.7.3	HYDROLOGICAL MONITORING	6-93
6.7.3.1	Pre-Application Monitoring Program	6-93
6.7.3.2	Site Preparation and Construction Monitoring Program	6-94
6.7.3.3	Pre-Operational Monitoring Program	6-94
6.7.3.4	Operational Monitoring Program	6-95
6.7.4	METEOROLOGICAL MONITORING	6-95
6.7.4.1	Wind Systems	6-96
6.7.4.2	Temperature Systems	6-96
6.7.4.3	Precipitation and Solar Radiation Systems	6-96
6.7.4.4	Maintenance and Calibration	6-96
6.7.4.5	Data Reduction	6-97
6.7.4.6	Accuracy of Measurements	6-97
6.7.5	ECOLOGICAL MONITORING	6-97
6.7.5.1	Terrestrial Ecology	6-97

TABLE OF CONTENTS (CONTINUED)

Section	Title	Page
6.7.5.2	Water Quality and Aquatic Life Monitoring	6-99
6.7.6	CHEMICAL MONITORING	6-100
6.7.6.1	Pre-Application Monitoring Program	6-101
6.7.6.2	Site Preparation, Construction, and Pre-Operational Monitoring Program	6-101
6.7.6.3	Operational Monitoring Program	6-101
6.7.6.4	Environmental Monitoring Program Quality Assurance and Quality Control Program	6-102
6.7.7	REFERENCES	6-102

LIST OF TABLES

Number	Title
6.1-1	Summary of Proposed Nonradiological Thermal, Physical, and Water Quality Monitoring Programs for HAR 2 and HAR 3
6.2-1	Radiological Environmental Sampling Locations Legend by Sample Type
6.2-2	Media Used to Assess Exposure Pathways to Humans
6.2-3	Radiological Environmental Sampling Locations Legend by HNP Station Number
6.4-1	HNP Meteorological Monitoring Tower Meteorological Sensor Elevations
6.4-2	HNP Meteorological Monitoring Tower Accuracy of Monitored Parameters
6.5-1	Terrestrial Ecology Monitoring
6.5-2	Aquatic Ecology Monitoring
6.6-1	Summary of Proposed Groundwater Chemical Monitoring Program for HAR 2 and HAR 3
6.7-1	Summary Describing Combined Monitoring Programs
6.7-2	Summary of Proposed Thermal, Physical, and Water Quality Monitoring Programs for Proposed HAR 2 and HAR 3
6.7-3	Radiological Environmental Sampling Locations by Sample Type
6.7-4	Media Used to Assess Exposure Pathways to Humans
6.7-5	Radiological Environmental Sampling Locations Legend by HNP Station Number
6.7-6	Summary of Proposed Hydrological Monitoring Program for Proposed HAR 2 and HAR 3
6.7-7	HNP Meteorological Monitoring Tower Meteorological Sensor Elevations
6.7-8	HNP Meteorological Monitoring Tower Accuracy of Monitored Parameters
6.7-9	Terrestrial Ecology Monitoring

LIST OF TABLES (CONTINUED)

Number	Title
6.7-10	Aquatic Ecology Monitoring

LIST OF FIGURES

Number	Title
6.1-1	Surface Water Monitoring Locations
6.2-1	Basic Pathways for Gaseous and Liquid Radioactive Effluent Releases to the Public
6.2-2	Sampling Locations Based on Distances from HAR
6.3-1	Hydrological Monitoring Program Wells and Piezometers
6.4-1	Location of the HNP Meteorological Monitoring Tower
6.6-1	Pre-Application Water Quality Groundwater Sampling Locations
6.6-2	Pre-Operational & Operational Water Quality Groundwater Sampling Locations

ACRONYMS AND ABBREVIATIONS

ºC	degrees Celsius
ºF	degrees Fahrenheit
ac.	acre
AC	air cartridge
ALARA	as low as reasonably achievable
ALMP	Ambient Lakes Monitoring Program
ANSI/ANS	American National Standards Institute/American Nuclear Society
AP	air particulate
APHA	American Public Health Association
AV	aquatic vegetation
bgs	below ground surface
BL	broadleaf vegetation
BMP	best management practice
CFR	Code of Federal Regulations
COL	Combined License
COLA	Combined License Application
CP&L	Carolina Power & Light Company
CWA	Clean Water Act
DO	dissolved oxygen
DQO	data quality objective
DW	drinking water
DWQ	Division of Water Quality

ACRONYMS AND ABBREVIATIONS (CONTINUED)

EAB	exclusion area boundary
EIS	Environmental Impact Statement
ER	Environmental Report
ESRI	Environmental Systems Research Institute
ESRP	Environmental Standard Review Plan
FC	food crops
FH	fish
FP	food products
FR	Federal Register
ft.	foot
$ft.^3$	cubic foot
g	gram
gal	gallon
G.S.	General Statute
GW	groundwater
ha	hectare
HAR	proposed Shearon Harris Nuclear Power Plant Units 2 and 3
HAR 2	proposed Shearon Harris Nuclear Power Plant Unit 2
HAR 3	proposed Shearon Harris Nuclear Power Plant Unit 3
HNP	existing Shearon Harris Nuclear Power Plant Unit 1
IEPA	Independent Energy Producers Association
in.	inch

ACRONYMS AND ABBREVIATIONS (CONTINUED)

in/hr	inch per hour
JVT	Joint Venture Team
kg	kilogram
km	kilometer
KFR	Kiker Forestry & Realty, Inc.
l	liter
lb	pound
LLD	Lower Limit of Detection
m	meter
MCFRBA	Middle Cape Fear River Basin Association
m/s	meters per second
mi.	mile
$mi.^2$	square miles
min.	minute
MK	milk
mm	millimeter
mm/h	millimeter(s) per hour
mph	miles per hour
msl	mean sea level
NAD27	North American Datum of 1927
NCDENR	North Carolina Department of Environment and Natural Resources
NCEMC	North Carolina Environmental Management Commission

ACRONYMS AND ABBREVIATIONS (CONTINUED)

NCGS	North Carolina Geological Survey
NCIBI	North Carolina Index of Biotic Integrity
NCNHP	North Carolina National Heritage Program
NCWRC	North Carolina Wildlife Resources Commission
NEMP	Nonradiological Environmental Monitoring Program
NGVD29	National Geodetic Vertical Datum 29
NHPA	National Historic Preservation Act
NIST	National Institute of Standards and Technology
NMFS	National Marine and Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
oz	ounce
PEC	Progress Energy Carolinas, Inc.
QA	quality assurance
QC	quality control
REMP	Radiological Environmental Monitoring Program
RFI	request for information
ROW	right-of-way
RTE	rare, threatened, and endangered species
SD	bottom sediment
SHPO	State Historic Preservation Office
SPT	standard penetration testing

ACRONYMS AND ABBREVIATIONS (CONTINUED)

SS	shoreline sediment
SW	surface water
TKN	Total Kjeldahl Nitrogen
TL	thermoluminescent
TLD	thermoluminescent dosimetry
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WTF	water treatment facility

6.0 ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

This chapter evaluates the environmental measurements and monitoring related to the operation of the proposed Shearon Harris Nuclear Power Plant Unit 2 (HAR 2), and the proposed Shearon Harris Nuclear Power Plant Unit 3 (HAR 3), as well as several appurtenant facilities (Figure 4.0-1). These appurtenant facilities include three new electric transmission lines, an electric switchyard, a Cape Fear River water intake structure and pumphouse, a makeup water pipeline, a discharge structure on Harris Reservoir, and a blowdown pipeline from HAR 2 and HAR 3 into Harris Reservoir.

This chapter is divided into seven sections:

- Section 6.1 — Thermal Monitoring
- Section 6.2 — Radiological Monitoring
- Section 6.3 — Hydrological Monitoring
- Section 6.4 — Meteorological Monitoring
- Section 6.5 — Ecological Monitoring
- Section 6.6 — Chemical Monitoring
- Section 6.7 — Summary of Monitoring Programs

For the purposes of this discussion and consistent with the information presented in Chapters 2, 4, and 5 of the Environmental Report (ER), the following terms are used:

- **Plant Site**. The plant site is the area within the fence line (Figure 4.0-2). This area includes the footprint of the HAR, including the reactor buildings and generating facilities.
- **HAR Site**. The HAR site is an irregularly shaped area comprised of the following site components: the plant site (area within the fence line), Harris Reservoir perimeter, the dam at Harris Reservoir, the pipeline corridor, and the intake structure and pumphouse (Figure 2.0-2). The HAR site is located within Wake and Chatham counties.
- **Exclusion Zone**. The area within the exclusion area boundary (EAB). The exclusion zone is represented by two circles, each with a radius of 1245 meters (m) (4085 feet [ft.]), centered on the reactor building of each unit (Figure 4.0-3).
- **Pipeline Corridor**. The pipeline corridor includes the Harris Lake makeup water system pipeline and corridor connecting the Harris Reservoir and

the Cape Fear River. The pipeline components will transport makeup water from the Cape Fear River to the Harris Reservoir (Figure 4.0-4).

- **Intake Structure and Pumphouse**. The Harris Lake makeup water system intake structure and pumphouse will be constructed on the Cape Fear River (Figure 4.0-5).

- **Harris Lake**. Harris Lake includes both the Harris Reservoir and the Auxiliary Reservoir.

- **Harris Reservoir**. The Harris Reservoir is also known as the Main Reservoir. It does not include the affiliated Auxiliary Reservoir.

- **Harris Reservoir Perimeter**. The Harris Reservoir perimeter describes the area impacted by the 6-m (20-ft.) change in the reservoir's water level.

- **Transmission Corridors and Off-Site Areas**. Transmission corridors and off-site areas describe areas outside of the site boundary that may fall within the footprint of new or existing transmission line corridors.

- **Vicinity**. The vicinity is a band or belt 9.7 kilometers (km) (6 miles [mi.]) wide surrounding the HAR site (Figure 2.0-6). The vicinity includes a much larger tract of land than the HAR site. The vicinity is located within four counties: Wake, Chatham, Harnett, and Lee.

- **Region**. The region applies to the area within an 80-km (50-mi.) radius from the center point of the HAR power block footprint, excluding the site and vicinity (Figure 4.0-6). The following counties are included entirely within the region: Chatham, Durham, Harnett, Lee, Orange, and Wake. The following counties are located partially within the region: Alamance, Caswell, Cumberland, Franklin, Granville, Guilford, Hoke, Johnston, Montgomery, Moore, Nash, Person, Randolph, Richmond, Robeson, Sampson, Scotland, Vance, Wayne, and Wilson. The region includes the economic centers of Raleigh, Durham, Fayetteville, Cary, and Chapel Hill.

Information about the six environmental measurements and monitoring programs for these resource areas is summarized in Section 6.7. Additional information on specific permit requirements discussed throughout Chapter 6 is outlined in Table 1.2-1 of ER Chapter 1.

Environmental measurements and monitoring programs for the existing Shearon Harris Nuclear Power Plant Unit 1 (HNP) will be ongoing during the pre-operational and construction phases of the HAR. Ultimately, the operational monitoring programs for the HAR and HNP will monitor the cumulative impacts of the operation of the three units.

6.1 THERMAL MONITORING

This section describes the Harris Lake thermal monitoring program that will be used to support the Combined License (COL) for the HAR. In general, the thermal monitoring program consists of the following primary elements:

- **Pre-Application Thermal Monitoring**. This phase of the monitoring is designed to establish background conditions and support the thermal descriptions that are presented in ER Subsection 2.3.3.

- **Pre-Operational Thermal Monitoring**. This phase of the monitoring is designed to establish a thermal baseline and document any changes in water temperature and thermal profiles resulting from site preparation and construction activities before facility operation.

- **Operational Thermal Monitoring**. This phase of the monitoring is used to establish changes in water temperature resulting from facility operation.

Progress Energy Carolinas, Inc. (PEC) currently monitors the water quality of Harris Reservoir to satisfy various environmental regulations, licenses, and permits associated with the operation of the HNP. PEC has also monitored water quality at the HNP site since 1972 in support of the original development of the HNP facility. Information available from the monitoring programs includes 5 years of monitoring prior to construction activities for the HNP (1972 to 1977), 9 years of water quality data during construction activities for the HNP (1978 through 1986), and approximately 20 years of data collected since the HNP began operations (1987 to the present).

In addition to the monitoring programs undertaken by PEC, the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Quality (DWQ) has periodically monitored Harris Reservoir under the Ambient Lakes Monitoring Program (ALMP). Under this program, the NCDENR DWQ collected temperature and chemical data at 101 drinking water reservoirs in North Carolina, including Harris Reservoir. Information available from this monitoring program indicates that 13 monitoring events during the late summer months have occurred at Harris Reservoir since 1987. These events were designed to target periods of reservoir stratification and increased algal activity. The records indicate that monitoring at Harris Reservoir occurred in the following years (with the number of times indicated in parentheses): 1987 (1), 1989 (1), 1990 (1), 1991 (1), 1993 (1), 1996 (1), 2001 (4), and 2003 (3) (Reference 6.1-001).

Figure 6.1-1 shows the locations where thermal, physical, and water quality measurements have or will be taken during the monitoring programs described previously.

The objectives of the thermal monitoring program will be to identify environmental effects, including potential changes to water temperature, caused by the

development and construction of HAR 2 and HAR 3, and to identify alternatives or engineering measures that could be used to reduce any adverse effects that may be identified.

6.1.1 PRE-APPLICATION THERMAL MONITORING

The objective of the pre-application thermal monitoring program was to establish background water temperatures from Harris Reservoir, Cape Fear River, and Buckhorn Creek before development and operation of HAR 2 and HAR 3. The thermal conditions presented in ER Subsection 2.3.3 are based on data collected for the HNP's existing Nonradiological Environmental Monitoring Program (NEMP) and to satisfy the requirements of the facility's National Pollutant Discharge Elimination System (NPDES) permit (Permit Number NC0039586). Thermal, physical, and water quality measurements conducted as part of the HNP NEMP was used as the basis for the pre-application thermal monitoring program for HAR 2 and HAR 3. Table 6.1-1 summarizes the locations and parameters monitored. Figure 6.1-1 shows the monitoring stations used for the NEMP and NPDES programs.

Available temperature information has been evaluated to determine if the data were sufficient to support existing environmental descriptions presented in ER Subsection 2.3.1. This data evaluation was based on the following items:

- Location and number of monitoring stations that consider such factors as the bathymetric characteristics of Harris Reservoir, type of cooling system employed and probable operating modes, transient hydrological parameters in the vicinity of the site, and vertical and horizontal lake temperature in the vicinity of the site.
- Sampling frequency and times that document temporal variations.
- Duration of the various monitoring programs.
- Data analysis procedures.

6.1.1.1 Freshwater Streams

The thermal conditions for Buckhorn Creek and the Cape Fear River are based on data collected by PEC during site preparation and construction activities for the HNP. These studies were performed during the period from 1978 to 1983 at sample locations BK2 and D2, which are shown on Figure 6.1-1. Monitoring Station BK2 is located approximately 3.2 km (2 mi.) downstream of the Main Dam spillway on Buckhorn Creek, and Monitoring Station D2 is located approximately 0.8 km (0.5 mi.) upstream of the convergence of the Cape Fear River and Buckhorn Creek. Monitoring Station D2 is located immediately upstream of the Buckhorn Dam at the proposed location of the Cape Fear makeup water intake structure. The NEMP was modified in 1984 to concentrate

monitoring efforts at major biological sampling stations. Water quality monitoring at locations BK2 and D2 was discontinued after 1983 (Reference 6.1-002).

In addition, between January 5, 1966 and September 27, 1983, the U.S. Geological Survey (USGS) collected thermal data from the Cape Fear River at the Lillington, North Carolina, gauging station (Station No. 02102500) at a location approximately 22 km (13.7 mi.) downstream of Buckhorn Creek (Reference 6.1-003). Thermal data have also been measured at two USGS gauging stations upstream of Buckhorn Creek: at the Haw River below the B. Everett Jordan Dam (Station No. 02098198), approximately 18.2 km (11.3 mi.), and at the Deep River at Moncure, North Carolina (Station No. 02102000), approximately 18.5 km (11.5 mi.). Thermal data collection dates for each monitoring station are available for the period April 1, 1980 through September 9, 2004, and October 15, 1963 through August 15, 2004, respectively (Reference 6.1-004 and Reference 6.1-005).

Pre-application monitoring was conducted in January 2007, and monthly thereafter, to verify and update background conditions at the time of the HAR Combined License Application (COLA). Pre-application thermal monitoring included temperature measurements collected at previous Monitoring Stations BK2 and D2 (Figure 6.1-1). Thermal measurements were collected concurrently with water samples, as specified in Section 6.6. Temperature, dissolved oxygen, pH, and conductivity measurements were collected at the surface of the stream using a YSI® Multiprobe or Multiparameter Instrument (or equivalent meter) (Table 6.1-1).

The existing thermal database is sufficient to describe thermal conditions in Buckhorn Creek and the Cape Fear River.

6.1.1.2 Lakes and Impoundments

The existing thermal database is sufficient to describe the thermal conditions in Harris Reservoir, as described in ER Subsection 2.3.3.2.1.The pre-application thermal monitoring program was conducted quarterly for the NEMP from 1983 to the present and included the collection of temperature measurements from the locations of the existing HNP monitoring stations. Figure 6.1-1 shows these stations, and the descriptions are as follows:

- **E2**. Site E2 is located in the Harris Reservoir near the Main Dam, downstream from the HNP NPDES Outfall 006. Data from this site were used to characterize thermal conditions associated with the discharge pipe and provide data to characterize the conditions of water being discharged to Buckhorn Creek.

- **P2**. Site P2 is located in the Harris Reservoir along the path of the cooling loop between the discharge of water into the lake and the cooling tower makeup water intake for the HNP site and the HAR site. Data from this site were used to characterize conditions along the cooling loop.

- **H2 and S2**. Sites H2 and S2 are located in the Harris Reservoir within the Buckhorn Creek Branch and White Oak Creek Branch, respectively. Data from these sites have been included to characterize background thermal conditions of water entering Harris Reservoir and possible dispersion conditions from the HNP NPDES Outfall 006 and the proposed outfall for HAR 2 and HAR 3.

At each of these sites, temperature measurements were collected at the surface and at 1-m (3.3-ft.) depth intervals to the bottom of the water body using a YSI® Multiprobe or Multiparameter Instrument (or equivalent meter). The thickness of the water column was also recorded. The temperature measurements at each site were taken at consistent depths and at a time of day (morning) that minimized the effect of diurnal solar warming. In addition, the monitoring was coordinated with the data collection activities conducted for the HNP to avoid duplicate efforts.

6.1.2 PRE-OPERATIONAL THERMAL MONITORING

The pre-operational thermal monitoring program is designed to continue the pre-application thermal monitoring activities during the developmental stages (site preparation and construction) of HAR 2 and HAR 3 until they are operational. The data will be used to supplement the pre-application thermal monitoring data by providing additional water temperature data during construction activities. The thermal, physical, and water quality measurements conducted as part of the HNP NEMP will be used as the basis for the pre-operational thermal monitoring program for HAR 2 and HAR 3. Table 6.1-1 summarizes the locations and parameters monitored. The proposed monitoring stations include the following:

- **V3**. Site V3 is located in the Harris Reservoir near the entrance to the cooling tower makeup water intake channel for the HNP. Data from this site will be used to characterize thermal conditions before usage within the cooling tower and indicate thermal changes in the Thomas Creek Branch of the Harris Reservoir immediately downstream of the HNP and HAR site.

- **MP1**. Site MP1 is located in the Harris Reservoir within the Little White Oak Creek Branch. Data from this site will be used to characterize background thermal conditions of the water entering the reservoir and possible dispersion conditions from the HNP NPDES Outfall 007.

- **MP2**. Site MP2 is located in the Auxiliary Reservoir near the Auxiliary Dam and the entrance to the Auxiliary Dam Spillway. Data from this site will be used to characterize thermal conditions before emergency usage for the HNP and to indicate thermal changes within the Auxiliary Reservoir. Data from this new location will also be used to characterize the conditions of water being discharged to the Harris Reservoir.

- **MP3**. Site MP3 is located within a branch of the Harris Reservoir immediately downstream of the Cape Fear makeup water discharge structure. Data from this site will be used to characterize background thermal conditions of the water entering the reservoir from the Cape Fear River.

The frequency of thermal monitoring will be modified to monthly events beginning approximately 1 year before construction activities to establish a refined baseline for water temperature in Harris Reservoir, Auxiliary Reservoir, Buckhorn Creek, and the Cape Fear River. In addition, the need for modifications to the monitoring program will be assessed regularly and over the duration of the pre-operational thermal monitoring program. Modifications to the pre-operational thermal monitoring program will consider the following objectives:

- Determine the temperature at locations appropriate to define the extent of existing mixing zones from the discharge outfall(s). Temperature should not exceed 2.8 degrees Celsius (ºC) (5 degrees Fahrenheit [ºF])) above the natural water temperature and 32 ºC (89.6 ºF) for the lower piedmont waters (Reference 6.1-006).

- Establish time-temperature relationships at all monitoring locations.

Additional locations and more frequent measurements during summer months may be incorporated into the pre-operational thermal monitoring program as the engineering design progresses, although the exact locations (e.g., some locations may be monitored remotely) and procedures may be modified. In addition, the monitoring will be coordinated with the data collection activities conducted for the HNP to avoid duplicate efforts.

6.1.3 OPERATIONAL THERMAL MONITORING

The operational thermal monitoring program will be implemented to establish changes in water temperature resulting from the HAR facility operation. The specific operational monitoring requirements will be developed in consultation with the NCDENR relative to NPDES permit requirements and the monitoring requirements for the HNP and for HAR 2 and HAR 3. Although the specific procedures of the operational thermal monitoring program have not been developed, it is anticipated that the monitoring stations will be similar to those used in the pre-operational thermal monitoring program. Thermal, physical, and water quality measurements conducted as part of the HNP NEMP will be used as the basis for the operational thermal monitoring program for HAR 2 and HAR 3. Table 6.1-1 summarizes the locations and parameters monitored, and Figure 6.1-1 shows the locations.

The data will be evaluated for temperature variability (relative to both distance from the discharge outfall[s] and vertical stratification) as well as temporal trends. Based on the monitoring data for the HNP, the operational thermal monitoring

program for HAR 2 and HAR 3 is anticipated to extend monthly for 2 years, bi-monthly for 3 years, and quarterly thereafter, beginning with operation of HAR 2 or HAR 3, or as conditions appear to stabilize based on trend analyses. Modifications to the operational thermal monitoring program (e.g., changes in monitoring stations and collection procedures) will be assessed regularly and over the duration of the monitoring program.

The operational monitoring program will be designed and approved after consultation with the appropriate resource agencies to ensure any operational effects are addressed and that the program provides statistically valid and defensible data per PEC's Quality Assurance/Quality Control (QA/QC) Program.

6.1.4 REFERENCES

6.1-001 North Carolina Environmental Management Commission, "Report to the Environmental Review Commission on the Status of Water Quality in Water Supply Reservoirs Sampled by the Division of Water Quality," April 2006.

6.1-002 Carolina Power & Light Company, "Shearon Harris Nuclear Power Plant, 1984 Annual Environmental Monitoring Report," September 1985.

6.1-003 U.S. Geological Survey, "Monitoring Station: 02102500 Cape Fear River at Lillington, NC," Website, www.nwis.waterdata.usgs.gov/nc/nwis/qwdata?site_no=02...pression=file&qw_sample_wide=0&submitted_form=brief_list, accessed January 8, 2007.

6.1-004 U.S. Geological Survey, "Monitoring Station: 02098198 Haw R Below B. Everett Jordan Dam NR Moncure, NC," Website, www.nwis.waterdata.usgs.gov/nc/nwis/qwdata?site_no=02...pression=file&qw_sample_wide=0&submitted_form=brief_list, accessed January 8, 2007.

6.1-005 U.S. Geological Survey, "Monitoring Station: 02102000 Deep River at Moncure, NC," Website, www.nwis.waterdata.usgs.gov/nc/nwis/qwdata?site_no=02...pression=file&qw_sample_wide=0&submitted_form=brief_list, accessed January 8, 2007.

6.1-006 North Carolina Department of Environment and Natural Resources, Division of Water Quality, "Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of N.C.," 15A North Carolina Administrative Code (NCAC) 2B.0200, Amended August 1, 2004.

Table 6.1-1 (Sheet 1 of 2)
Summary of Proposed Nonradiological Thermal, Physical, and Water Quality Monitoring Programs for HAR 2 and HAR 3

Description	Pre-Application[a]	Pre-Operational	Operational
Objective of Sampling Program	Establish background water quality in Harris Reservoir, Buckhorn Creek, and Cape Fear River before site preparation and construction activities.	Establish baseline and document water quality changes during site preparation and construction activities.	Document water quality changes during operation.
Sites Monitored	E2, H2, P2, S2[b], BK2[c], and D2[c] (See Figure 6.1-1)	E2, H2, P2, S2, V3[d], MP1[d], MP2[d], MP3[d], BK2[c], and D2[c] (See Figure 6.1-1)	E2, H2, P2, S2, V3[d], MP1[c], MP2[d], MP3[d], BK2[c], and D2[c] (See Figure 6.1-1)
Frequency	E2, H2, P2, and S2[b] : quarterly BK2[c] and D2[c]: monthly	Bi-monthly beginning approximately 1 year before site preparation activities (increase frequency if notable changes occur).	Monthly (for 2 years), bi-monthly (for 3 years), and quarterly thereafter.
Field Parameters	Water temperature[e] Dissolved oxygen pH Turbidity Specific conductance Water clarity Depth-to-bottom	Water temperature[e] Dissolved oxygen pH Turbidity Specific conductance Water clarity Depth-to-bottom	Water temperature[e] Dissolved oxygen pH Turbidity Specific conductance Water clarity Depth-to-bottom
Collection Points for Field Parameters	Surface to bottom at 1-m (3.3-ft.) depth intervals	Surface to bottom at 1-m (3.3-ft.) depth intervals	Surface to bottom at 1-m (3.3-ft.) depth intervals
Water Quality Parameters	**General Water Chemistry** Alkalinity, total Ammonia-N Chloride Hardness Nitrate + Nitrite-N Total Kjeldahl Nitrogen (TKN) Phosphorous, total Sulfate Total dissolved solids Total organic carbon	**General Water Chemistry** Alkalinity, total Ammonia-N Chloride Hardness Nitrate + Nitrite-N TKN Orthophosphate[f] Phosphorous, total Sulfate Sulfide[f] Total dissolved solids Total organic carbon Total suspended solids[f]	**General Water Chemistry** Alkalinity, total Ammonia-N Chloride Hardness Nitrate + Nitrite-N TKN Orthophosphate[f] Phosphorous, total Sulfate Sulfide[f] Total dissolved solids Total organic carbon Total suspended solids[f]

Table 6.1-1 (Sheet 2 of 2)
Summary of Proposed Nonradiological Thermal, Physical, and Water Quality Monitoring Programs for HAR 2 and HAR 3

Description	Pre-Application[a]	Pre-Operational	Operational
Water Quality Parameters	**Biological** Chlorophyll *a*	**Biological** Chlorophyll *a* Biological Oxygen Demand[f] Chemical Oxygen Demand[f]	**Biological** Chlorophyll *a* Biological Oxygen Demand[f] Chemical Oxygen Demand[f]
	Metals Calcium Copper Magnesium Manganese Sodium	**Metals** Arsenic[f] Boron[f] Calcium Copper Chromium[f] Iron[f] Lead[f] Magnesium Manganese Mercury[f] Nickel[f] Potassium[f] Sodium Zinc[f]	**Metals** Arsenic[f] Boron[f] Calcium Copper Chromium[f] Iron[f] Lead[f] Magnesium Manganese Mercury[f] Nickel[f] Potassium[f] Sodium Zinc[f]
Collection Points for Water Quality Parameters	0.2 m (0.7 ft.) below surface for all surface water sample locations. For lake monitoring stations only, also collect samples from within 1 m (3.3 ft.) of the lake bottom.	0.2 m (0.7 ft.) below surface for all surface water sample locations. For lake monitoring stations only, also collect samples from within 1 m (3.3 ft.) of the lake bottom.	0.2 m (0.7 ft.) below surface for all surface water sample locations. For lake monitoring stations only, also collect samples from within 1 m (3.3 ft.) of the lake bottom.
Data Analysis	Statistical trend analysis	Statistical trend analysis	Statistical trend analysis

Notes:
a) Historical information is collected from the HNP's Nonradiological Annual Environmental Monitoring Reports, 1983 through current, and grab samples from identified locations.

b) Monitoring Station S2 was not sampled from 1984 through 1988 for the Nonradiological Environmental Monitoring Program.

c) Monitoring Stations BK2 and D2 are added to the existing water sampling locations for the pre-application, pre-operational, and operational monitoring programs.

d) Monitoring Stations V3, MP1, MP2, and MP3 are added to the existing water sampling locations for the pre-operational and operational monitoring programs.

e) Temperature measurements at each site are collected at consistent depths and at a time of day (morning) that minimizes the effect of diurnal solar warming.

f) Parameter is added to the existing water quality list for the pre-operational and operational monitoring programs.

6.2 RADIOLOGICAL MONITORING

The proposed Radiological Environmental Monitoring Program (REMP) for HAR 2 and HAR 3 will be designed to monitor the following:

- The radiological environment before the pre-construction and construction phases from HNP operations.
- The radiological environment surrounding the HAR during active facility operations.

The primary objective of the proposed REMP is to monitor for potential radiological exposures to operations and construction workers, the public, and the surrounding environment during construction and active facility operations. To the greatest extent practical, HAR will use HNP monitoring and sampling equipment as well as already established monitoring or sampling locations. This section describes an anticipated REMP program compatible with the existing HNP program, and may be subject to change.

6.2.1 PROPOSED RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The proposed REMP will be implemented in accordance with 10 Code of Federal Regulations (CFR) 20.1501 and Criterion 64 of 10 CFR 50, Appendix A. The program will be developed using the following guidance published by the U.S. Nuclear Regulatory Commission (NRC):

- Regulatory Guide 4.1, Revision 1, “Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants.”
- Regulatory Guide 4.13, Revision 1, “Performance, Testing, and Procedural Specifications for Thermoluminescence Dosimetry; Environmental Applications.”
- Regulatory Guide 4.15, Revision 1, “Quality Assurance for Radiological Monitoring Programs (Normal Operations) – Effluent Streams and the Environment.”
- Regulatory Guide 1.109, Revision 1, “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.”

The purpose of the proposed REMP is to sample, measure, analyze, and monitor the radiological effects of proposed reactor operations on the environment. The proposed REMP has the following objectives:

- Identification, measurement, and evaluation of existing radionuclides in the environs of the HAR and fluctuations in radioactivity levels that may occur.

- Evaluation of the measurements to determine the effects on proposed operations relative to the local radiological environment.

- Collection of data needed to refine environmental radiation transport models used in off-site dose calculations.

- Verification that radioactive material containment systems are functioning to minimize environmental releases to levels as low as reasonably achievable (ALARA).

- Demonstration of compliance with regulations.

Implicit in these objectives are the requirements to analyze trends and assess radiation exposure rates and radioactivity concentrations in the environment that may contribute to radiation exposure to construction workers and the public. The program will consist of two phases: pre-operational and operational.

- **Pre-Operational Radiological Environmental Monitoring**. The pre-operational REMP will be used to establish the baseline for the local radiation environment. The purpose of the pre-operational REMP is to measure background levels and their variations along the anticipated critical pathways in the area surrounding the HAR, to train personnel, and to evaluate procedures, equipment, and techniques. However, because the proposed reactors will be sited near the HNP, the proposed pre-operational and operational phases of the REMP were developed from baseline data already established for the HNP.

- **Operational Radiological Environmental Monitoring**. The operational REMP will implement measurements to verify that the in-station controls for the release of radioactive material are functioning the way they were designed to function.

The elements (sampling media and analysis type) for both the pre-operational and operational REMP phases will be essentially the same. To the greatest extent practical, the proposed REMP will use the same sampling locations used by the HNP's existing REMP. New sampling locations may be selected based on the selected plant design parameters.

Figure 6.2-1 presents the basic pathways for gaseous and liquid radioactive effluent releases to the public. The "important pathways" selected are based primarily on how radionuclides move through the environment and how they will eventually expose the public, taking into consideration people's use of the environment.

The scope of the program will include monitoring the media identified in Table 6.2-2.

6.2.2 SAMPLE AND CONTROL LOCATIONS

Pathways will be monitored at sample and control locations. Sample locations were chosen by the HNP based on meteorological factors, pre-operational monitoring, and results of the land use surveys (Reference 6.2-001). A number of locations have been selected as controls. The following list provides information about the control locations, along with distances from the HAR (Reference 6.2-001):

- HNP Control Location 5 (Air Sampling-Air Cartridge and Air Particulate-thermoluminescent dosimetries [TLDs]) — 21.4 km (13.4 mi.) west-northwest — Pittsboro.
- HNP Control Location 45 (Fish) — Site varies in Cape Fear River above Buckhorn Dam.
- HNP Control Location 38 (Drinking Water and Surface Water) — 10 km (6.2 mi.) west-southwest.
- HNP Control Location 5 (Milk) — 29.1 km (18.2 mi.) west-northwest — Manco Dairy.
- HNP Control Location 5 (Food Crops or Food Products) — 28.8 km (18 mi.) north-northwest — Pittsboro.
- HNP Control Location 5 (Broadleaf Vegetation) — 19.3 km (12 mi.) north-northwest — Pittsboro.

Samples from these control locations will provide a basis for measuring background fluctuations in radioactivity at sample locations relative to natural phenomena and fallout. Through comparisons with these control locations, increases in radioactive material concentrations at a sample location, resulting in part from active facility operations, will be distinguishable.

Locations for sampling are already established for the operation of the HNP. The sample locations and control locations are described in Table 6.2-1 and Table 6.2-3 and shown on Figure 6.2-2. Initially, these sample locations and control locations will be used for the HAR facility as baseline locations and for gathering data to indicate the radiological environment before operation of the HAR facility. These locations were selected primarily based on where the highest predicted environmental radiological concentrations occur. Different locations may be selected once the proposed reactors are actively operating.

6.2.3 SAMPLE ANALYSIS

Concentrations of radioactivity present in the environment vary as a result of factors, such as weather conditions and differences in sampling collection techniques and sample analysis.

Several types of measurements will be performed to provide information about the types of radiation and radionuclides present. Analyses performed on environmental samples collected will include the following:

- Gross beta analysis.
- Gamma spectroscopy analysis.
- Tritium analysis.
- Iodine-131 analysis.
- Gamma dose (TLD only).

6.2.3.1 Lower Limit of Detection for Sample Analyses

The lower limit of detection (LLD) is the smallest concentration of radioactive material in a sample that will yield a net count above system background that will be detected with 95 percent probability and with only 5 percent probability of falsely concluding that a blank observation represents a “real” signal (Reference 6.2-001).

For all sample analysis for the HAR, the LLDs established in Table 4 of PEC’s “Annual Radiological Environmental Operating Amended Report for 2004” will be used (Reference 6.2-001).

6.2.3.2 Direct Radiation Monitoring

Radionuclides present in the air, in addition to those deposited on the ground, will expose humans by immersion in the atmosphere or by deposition on the ground. The TLDs will be used to measure the ambient gamma radiation levels at many locations surrounding the HAR.

A TLD measures ionizing radiation exposure by measuring the amount of visible light emitted from a crystal in a chamber where the crystal is heated. The amount of light emitted is dependant on the amount of radiation absorbed. (Reference 6.2-002)

Either the HNP monitoring stations will be used or new ones placed near the facility and approximately 8 km (5 mi.) from the proposed reactors in locations representing the 16 meteorological compass sectors. Other locations have been

or will be chosen to measure the radiation levels at places of special interest, such as nearby residences, meeting places, and population centers.

Control locations were previously established by HNP and are located farther than 16 km (10 mi.) from the facility, in areas that will not be influenced by active facility operations. New control locations may be selected based on HAR operations.

6.2.3.3 Air Monitoring

The inhalation and ingestion of radionuclides in the air is a direct exposure pathway to humans and animals. A network of active air samplers will be used to monitor this pathway from the vent stacks, which include the plant vent stack, turbine building vent stack, and the waste processing building vent stacks (2) (Reference 6.2-003). Air sampling stations will be strategically located in areas most likely to reveal any measurable effects resulting from the release of radioactive effluents from the HAR. The control will be located at Pittsboro, approximately 21 km (13.4 mi.) west-northwest of the HAR.

The air sampling equipment will be maintained and calibrated by facility personnel using reference standards traceable back to the National Institute of Standards and Technology (NIST).

Air samples will be collected and analyzed at the frequency levels and for the constituents specified in Table 6.2-1.

6.2.3.4 Aquatic Monitoring

The HAR will use the existing Harris Reservoir as the source for raw water and cooling tower makeup water. The HAR will discharge cooling tower blowdown to the reservoir. If radioactive liquid effluents were to be discharged from the proposed reactors into the cooling water outfall, long-lived radioisotopes could build up over a period of time, because the same water is reused on successive trips through the facility. Although the only user of the Harris Reservoir as a source of drinking water is PEC, the reservoir is a recreational facility used for fishing, swimming, water skiing, boating, and hunting.

Harris Reservoir and its tributaries constitute the primary environmental exposure pathway for radioactive materials from liquid effluents. Aquatic vegetation, fish, and sediments will be collected to detect the presence of any radioisotopes related to the operation of the HAR. These samples will be analyzed for naturally occurring and artificially produced radioactive materials. Both sample and control locations will be taken from various locations throughout Harris Reservoir and downstream of Harris Reservoir.

6.2.3.4.1 Aquatic Vegetation

Aquatic vegetation samples will be obtained annually and analyzed as specified in Table 6.2-1. The Harris Reservoir aquatic vegetation poses no radiological exposure risk to the public by way of this pathway because it is not an ingestion pathway. These samples are for long-term trending analysis only (Reference 6.2-001).

6.2.3.4.2 Fish

Various samples of fish will be collected from Harris Reservoir and from the Cape Fear River above Buckhorn Dam. These samples will consist of free swimmers and bottom feeders. Fish ingest sediments during bottom feeding, or prey on other organisms that also ingest sediments. Those sediments may retain radionuclides (Reference 6.2-002). A radiological analysis from fish samples will provide key information on the potential ingestion of radionuclides by humans by way of this aquatic pathway. These samples will be collected semi-annually and analyzed, as specified in Table 6.2-1.

6.2.3.4.3 Shoreline Sediments

Samples of shoreline sediments will be collected at Harris Reservoir. Radiological analyses of sediments will provide information on any potential shoreline exposure to humans by determining long-term trends and the accumulation of long-lived radionuclides from the environment. Samples will be collected semi-annually and analyzed, as specified in Table 6.2-1.

6.2.3.5 Terrestrial Monitoring

In addition to direct radiation, radionuclides present in the atmosphere expose receptors when deposited on plants and soil and subsequently consumed. To monitor this food pathway, samples of milk and broadleaf vegetation will be analyzed, when available.

6.2.3.5.1 Milk

There is no known commercial production of milk for human consumption within an 8-km (5-mi.) radius of the HAR (Reference 6.2-001). Milk samples will be collected when there are milk animals within a 5-mi. radius of the plant used for human consumption.

6.2.3.5.2 Broadleaf Vegetation

Broadleaf sampling is performed in the absence of milk animals (used for human consumption) within a 5-mi. radius of the plant. Surface vegetation samples will be collected monthly during the growing season from a number of locations to monitor the potential buildup of atmospherically deposited radionuclides. The radionuclides of interest, relative to the HNP facility operations, are already

present within our environment. These radionuclides are from several decades of worldwide fallout or from naturally occurring sources. Therefore, the presence of these radionuclides is anticipated from the samples collected. These samples will be analyzed following the requirements specified in Table 6.2-1.

Broadleaf vegetation samples will be obtained from two sample locations and one control location. The sample locations will be in the meteorological sectors with the highest potential for surface deposition. The control location will be a meteorological sector with a distance approximately 19 km (12 mi.) downwind north-northwest of the facility. Samples will be collected once a month during the growing season (June through September) and will be analyzed following the requirements specified in Table 6.2-1.

6.2.3.6 Water Monitoring

Water monitoring (e.g., the collection of drinking water, surface water, and groundwater [well water] samples) will be used to detect the presence of any radioisotopes relative to the operation of the HAR. Samples taken will be analyzed following the requirements specified in Table 6.2-1.

6.2.3.6.1 Drinking Water

Drinking water grab sampling is performed at the HNP Water Treatment Facility (WTF). Composite water samplers are located on the river as shown in Figure 6.2-2 for location No.38 (control-Cape Fear Plant) and location No. 40 (indicator-Lillington). Samplers will collect a small, fixed-volume sample of water at hourly intervals. Samplers will then discharge the sample into a common sample collection bottle. This two-week composite sample will be analyzed following the requirements listed in Table 6.2-1. A portion of these two-week composite samples will then be combined with other monthly samples collected during the calendar quarter. This quarterly composite sample will be analyzed following the requirements specified in Table 6.2-1.

6.2.3.6.2 Surface Water

Composite water samplers will be installed at several locations to sample surface water. These composite water samplers will collect a small volume of surface water at regular intervals and discharge the sample into a large sample collection bottle. This water sample will be collected on a weekly basis and combined into a composite water sample on a monthly basis.

Samplers will be located approximately 7.5 km (4.7 mi.) south of the HAR, 9.9 km (6.2 mi.) west-southwest, and 27.5 km (17.2 mi.) south-southeast of Lillington as shown in Table 6.2-1.

Surface water samples will be analyzed following the requirements listed in Table 6.2-1.

6.2.3.6.3 Groundwater Monitoring

Groundwater samples will be collected quarterly at locations on-site and analyzed as specified in Table 6.2-1. Progress Energy is committed to compliance with the Industry Ground Water Protection Initiative (NEI 07-07) and as such will ensure that the guidance in NEI 07-07 is followed with regard to management and response to instances where the inadvertent release of radioactive substances may result in low but detectable levels of plant-related materials in subsurface soils and water.

6.2.4 QUALITY ASSURANCE PROGRAM

The standards for the QA Program are established in the NRC Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs." The purpose of the QA program is "(1) to identify deficiencies in the sampling and measurement processes to those responsible for these operations so that corrective action can be taken, and (2) to obtain some measure of confidence in the results of the monitoring programs in order to assure the regulatory agencies and the public that the results are valid." (Reference 6.2-001)

The QA program provides the opportunity to implement corrective actions that address possible deficiencies. Examples of the activities of the QA program include the following (Reference 6.2-001):

- Perform duplicate analysis of the samples (excluding TLDs) to check laboratory precision.
- Perform regular review of sample collection and records.
- Perform regular review of laboratory procedures and methods.
- Count quality indicator and control samples routinely.
- Review analytical results provided by the laboratory monthly to validate that the required minimum sensitivities have been achieved, and the correct analyses have been performed.
- Ensure known concentrations of radioactivity are used by the laboratory in test samples to ensure consistent quality results on an ongoing basis.
- Incorporate REMP activities into the construction phase QA program established pursuant to 10 CFR 50, Appendix B, during HAR Combined License Application (COLA) activities to establish confidence and credibility that the data collected and reported are accurate and precise.
- Ensure laboratory participation in intercomparison programs, such as the U.S. Environmental Protection Agency (USEPA) QA crosscheck program.

The proposed REMP will use QA programs and processes to accomplish the following tasks:

- Ensure personnel will be trained and qualified to perform radiological monitoring.
- Ensure laboratory processes will be documented (i.e., maintenance, storage, and use of radioactivity reference standards), and calibration and checks of radiation radioactivity measurement systems and sample tracking and control will be performed.
- Ensure the processes and procedures of the REMP will be documented.
- Ensure periodic audits of analysis laboratory functions and their facilities will be conducted.

6.2.5 REFERENCES

6.2-001 Progress Energy Carolinas, Inc., “Annual Radiological Environmental Operating Amended Report for 2004,” Shearon Harris Nuclear Power Plant, Docket No. 50-400/License No. NPF-63, September 23, 2005.

6.2-002 Campbell, Robert J., "Annual Radioactive Environmental Operating Report for the Clinton Power Station: 01 January 2001 – 31 December 2001," 2001.

6.2-003 Progress Energy Carolinas, Inc., "Annual Radioactive Effluent Release Report, January 1, 2004 to December 31, 2004," Shearon Harris Nuclear Power Plant, Facility Operating License No. NPF-063, Docket No. 50-400, April 12, 2005.

Table 6.2-1 (Sheet 1 of 3)
Radiological Environmental Sampling Locations Legend by Sample Type

Sample Type	Station Number and Location	Frequency	Sample Size	Analysis
Air Cartridge (AC)	1 – 4.1 km (2.6 mi.) N 2 – 2.2 km (1.4 mi.) NNE 4 – 4.9 km (3.1 mi.) NNE 5 – 21.4 km (13.4 mi.) WNW – Pittsboro[(a)] 26 – 7.5 km (4.7 mi.) S 47 – 5.4 km (3.4 mi.) SSW	As required because of dust loading but at a minimum every 7 days	275 m^3 (9712 $ft.^3$)	Iodine-131
Air Particulate (AP)	1 – 4.1 km (2.6 mi.) N 2 – 2.2 km (1.4 mi.) NNE 4 – 4.9 km (3.1 mi.) NNE 5 – 21.4 km (13.4 mi.) WNW – Pittsboro[(a)] 26 – 7.5 km (4.7 mi.) S 47 – 5.4 km (3.4 mi.) SSW	As required because of dust loading but at a minimum every 7 days	275 m^3 (9712 $ft.^3$)	Gross Beta (Weekly) Composite Gamma (Quarterly)
Fish (FH)	44 – Site varies in Harris Reservoir 45 – Site varies in Cape Fear River above Buckhorn Dam[(a)]	Semi-annual	1 kilogram (kg) (2.2 pounds [lb.]) (wet) Free Swimmers and Bottom Feeders	Gamma
Drinking Water (DW)	38 – 9.9 km (6.2 mi.) WSW[(a)] 40 – 27.5 km (17.2 mi.) SSE – Lillington 51 – Water Treatment Plant (on-site)	2-Week Composite Monthly Composite Quarterly Composite	8 liter (l) (2.1 [gallon] gal.)	Iodine-131, Gamma, Tritium, Gross Beta
Groundwater (GW)	39 – 1.1 km (0.7 mi.) SSW 57 – 0.6 km (0.4 mi.) SSW 58 – 0.8 km (0.5 mi.) WSW 59 – 0.8 km (0.5 mi.) NNE 60 – 0.8 km (0.5 mi.) ESE	Quarterly	4 L (1.1 gal.)	Gamma, Tritium
Milk (MK)	5 – 29.1 km (18.2 mi.) WNW – Manco Dairy[(a)]	Semi-monthly (when milk animals w/in 5 mi.)	8 L (2.1 gal.)	Iodine-131, Gamma
Shoreline Sediments (SS)	26 – 7.4 km (4.6 mi.) S 41 – 6.0 km (3.8 mi.) S	Semi-annual	500 grams (g) (17.6 ounces [oz])	Gross Beta, Gamma

Table 6.2-1 (Sheet 2 of 3)
Radiological Environmental Sampling Locations Legend by Sample Type

Sample Type	Station Number and Location	Frequency	Sample Size	Analysis
Surface Water (SW)	26 – 7.5 km (4.7 mi.) S 38 – 9.9 km (6.2 mi.) WSW[(a)] 40 – 27.5 km (17.2 mi.) SSE – Lillington	Weekly/ Monthly/ Quarterly Composite	8 L (2.1 gal.)	Iodine-131, Gamma Isotopic, Tritium, Gross Beta
Aquatic Vegetation (AV)	26 – 7.5 km (4.7 mi.) S 41 – 6.0 km (3.8 mi.) S 61 – 4.0 km (2.5 mi.) E	Annually	500 g (17.6 oz.)	Gamma
Food Crops (FC) or Food Products (FP)	5 – 28.8 km (18.0 mi.) NNW – Pittsboro[(a)] 54 – 2.7 km (1.7 mi.) NNE – Wilkins or Morris 55 – 3.2 km (2.0 mi.) NNW – L.L. Goodwin 62 – 3.7 km (2.3 mi.) NE – Lee 64 – 2.9 km (1.8 mi.) ENE – Michael	Three different kinds of broadleaf vegetation monthly during the growing season	500 g (17.6 oz.)	Gamma
Broadleaf Vegetation (BL)	65 – 2.2 km (1.4 mi.) S – Site Boundary 66 – 2.1 km (1.3 mi.) SSW – Site Boundary 5 – 19.2 km (12.0 mi.) NNW – Pittsboro[(a)]	Monthly	500 g (17.6 oz.)	Gross Beta, Gamma, Iodine-131.
Thermo-luminescent Dosimetry (TL or TLD)	1 – 4.1 km (2.6 mi.) N 1 – 4.1 km (2.6 mi.) N 2 – 2.2 km (1.4 mi.) NNE 3 – 3.0 km (1.9 mi.) ENE 4 – 4.9 km (3.1 mi.) NNE 5 – 21.4 km (13.4 mi.) WNW – Pittsboro[(a)] 6 – 1.3 km (0.8 mi.) NE 7 – 1.1 km (0.7 mi.) E 8 – 1.0 km (0.6 mi.) ESE 9 – 3.5 km (2.2 mi.) SE 10 – 3.5 km (2.2 mi.) SSE 11 – 1.0 km (0.6 mi.) S 12 – 1.4 km (0.9 mi.) SSW 13 – 1.1 km (0.7 mi.) WSW 14 – 2.4 km (1.5 mi.) W 15 – 3.2 km (2.0 mi.) W 16 – 3.0 km (1.9 mi.) WNW 17 – 2.4 km (1.5 mi.) NW 18 – 2.2 km (1.4 mi.) NNW 19 – 8.0 km (5.0 mi.) NNE	Quarterly	Not Applicable	TLD Reading

Table 6.2-1 (Sheet 3 of 3)
Radiological Environmental Sampling Locations Legend by Sample Type

Sample Type	Station Number and Location	Frequency	Sample Size	Analysis
	20 – 7.2 km (4.5 mi.) NE 21 – 7.7 km (4.8 mi.) ENE 22 – 6.9 km (4.3 mi.) E 23 – 7.7 km (4.8 mi.) ESE 24 – 6.4 km (4.0 mi.) SE 25 – 7.5 km (4.7 mi.) SSE 26 – 7.5 km (4.7 mi.) S 27 – 7.7 km (4.8 mi.) SW 28 – 7.7 km (4.8 mi.) SSW 29 – 9.1 km (5.7 mi.) WSW 30 – 8.9 km (5.6 mi.) W 31 – 7.5 km (4.7 mi.) WNW 32 – 10.2 km (6.4 mi.) NNW 33 – 7.2 km (4.5 mi.) NNW 34 – 13.9 km (8.7 mi.) NE – Apex 35 – 11.0 km (6.9 mi.) E – Holly Springs 36 – 17.4 km (10.9 mi.) E 37 – 14.7 km (9.2 mi.) ESE – Fuquay-Varina 48 – 7.2 km (4.5 mi.) N 49 – 4.0 km (2.5 mi.) NNE 50 – 4.1 km (2.6 mi.) ESE 53 – 9.3 km (5.8 mi.) NW 56 – 4.8 km (3.0 mi.) WSW 63 – 1.0 km (0.6 mi.) SW 67 – 1.9 km (1.2 mi.) ENE			

Notes:

a) Control Locations

E = East
N = North
S = South
W = West

Source: Reference 6.2-003

Table 6.2-2
Media Used to Assess Exposure Pathways to Humans

Pathway Exposure to Humans	Media Sampled
External Dose	Thermoluminescent Dosimetry (TLD)
	Shoreline Sediments (SS)
Ingestion	Aquatic Vegetation (AV)
	Drinking Water (DW)
	Food Crops (FC)
	Fish (FH)
	Groundwater (GW)
	Milk (MK)
	Broadleaf Vegetation (when milk samples are unavailable) (BL)
	Surface Water (SW)
Inhalation	Air Samples (Particulate and Iodine)

Source: Reference 6.2-001

Table 6.2-3
Radiological Environmental Sampling Locations Legend by HNP Station Number

HNP Station Number	Sample Type	Figure 6.2-2 Sheet:	HNP Station Number	Sample Type	Figure 6.2-2 Sheet:
1	AP, AC, TL	3	35	TL	2
2	AP, AC, TL	3	36	TL	2
3	TL	3	37	TL	2
4	AP, AC, TL	3	38	SW, DW	2
5	AP, AC, MK, FC, TL, BL	1	39	GW	3
6	TL	3	40	SW, DW	2
7	TL	3	41	SS, AV	3
8	TL	3	42	MK	2
9	TL	3	43	DELETED	---
10	TL	3	44	FH	3
11	TL	3	45	FH	1
12	TL	3	46	DELETED	---
13	TL	3	47	AP, AC	3
14	TL	3	48	TL	2
15	TL	3	49	TL	3
16	TL	3	50	TL	3
17	TL	3	51	DW	3
18	TL	3	52	SD	3
19	TL	2	53	TL	1
20	TL	2, 3	54	FC	3
21	TL	2	55	FC	3
22	TL	2	56	TL	3
23	TL	2	57	GW	3
24	TL	2	58	GW	3
25	TL	2, 3	59	GW	3
26	AP, AC, AV, SS, SW, TL	2, 3	60	GW	3
27	TL	2, 3	61	AV	2
28	TL	2, 3	62	FC	3
29	TL	1	63	TL	3
30	TL	1	64	FC	3
31	TL	1	65	BL	3
32	TL	1	66	BL	3
33	TL	2	67	TL	3
34	TL	2			

Notes:
AC = Air Cartridge
AP = Air Particulate
AV = Aquatic Vegetation
BL = Broad Leaf
DW = Drinking Water
FC = Food Crop
FH = Fish
GW = Groundwater
MK = Milk
SD = Bottom Sediment
SS = Shoreline Sediment
SW = Surface Water
TL = TLD

Source: Reference 6.2-003

6.3 HYDROLOGICAL MONITORING

This section describes surface water and groundwater hydrological monitoring programs that will be used to support the COLA for HAR 2 and HAR 3.

The objectives of the surface water and groundwater hydrological monitoring program will be to identify environmental effects, including the changes to surface water and groundwater, caused by the development and construction of HAR 2 and HAR 3, and to identify alternatives or engineering measures that could be used to reduce any adverse effects that may be identified.

In general, the surface water and groundwater hydrological monitoring programs will consist of the following primary elements:

- **Pre-Application Hydrological Monitoring**. This phase of the monitoring will support the background hydrologic descriptions presented in ER Section 2.3.

- **Construction Hydrological Monitoring**. This phase of the monitoring will be used as a basis to control and limit effects to surface water and groundwater that could result from site preparation and construction activities.

- **Pre-Operational Hydrological Monitoring**. This phase of the monitoring will establish a baseline from which the identification and assessment of environmental effects attributable to HAR facility operation can be made.

- **Operational Hydrological Monitoring**. This phase of the monitoring will document effects from HAR facility operation.

In an effort not to duplicate monitoring efforts, PEC will coordinate its hydrological monitoring with existing hydrological monitoring programs and efforts being performed by the HNP and other applicable groups or agencies. Any proposed hydrological monitoring would be implemented at an appropriate time, in regard to the commencement of proposed site preparation or construction activities. Monitoring will span the period of pre-application through the operational phases of the HAR site.

During each phase of the project, results of the previous monitoring program will be reviewed periodically to ensure that the monitoring efforts are sufficient. Modifications will be made to the program, as needed, based on the data results. If outputs of a preceding phase of the program demonstrate no significant effects, provisions to study such effects in successive monitoring programs will be reduced or eliminated.

The following sections present information regarding the hydrological monitoring of freshwater streams, lakes and impoundments, and surficial/bedrock aquifers

within the vicinity of the HAR site likely to be affected by site preparation and construction activities, pre-operation, and operation of the HAR facility.

6.3.1 PRE-APPLICATION HYDROLOGICAL MONITORING PROGRAM

The objective of the pre-application hydrological monitoring program is to establish background conditions for surface water and groundwater before the construction and operation of HAR 2 and HAR 3. Available hydrological and hydrogeological information was evaluated to determine if the data were sufficient to support the existing environmental descriptions presented in ER Subsection 2.3.1. This data evaluation was based on the following considerations:

- Location and number of monitoring stations that considers factors, such as the bathymetric characteristics of Harris Lake (Main or Harris Reservoir and Auxiliary Reservoir), soil and groundwater system characteristics, type of cooling system to be employed and probable operating modes, and transient hydrological parameters near the site.
- Sampling frequency and times that document temporal variations.
- Duration of the various monitoring programs.
- Sediment transport characteristics.

6.3.1.1 Freshwater Streams

The hydrologic conditions for Buckhorn Creek are based on data collected at a USGS gauging station (USGS Station No. 02102192, Buckhorn Creek, near Corinth, North Carolina) located approximately 914 m (3000 feet [ft.]), 0.9 kilometers [km] (0.56 miles [mi.]) below the Main Dam Spillway. Periods of record for data collected include (1) June 9, 1972, to present for stream stage and flow measurements and (2) December 15, 1972, through September 1, 1978, for suspended sediment concentrations. The drainage area at the station is 198 square kilometers (km^2) (76.3 square miles [$mi.^2$]) (Reference 6.3-001).

The existing hydrologic data are sufficient to describe hydrologic conditions in Buckhorn Creek. The proposed pre-application monitoring includes the continued collection and evaluation of stream stage and flow measurements in Buckhorn Creek downstream of the Main Dam Spillway at the USGS Buckhorn Creek gauging station. The recommended monitoring supplements the existing database to support the description of background conditions in Buckhorn Creek, downstream from Harris Reservoir.

6.3.1.2 Lakes and Impoundments

Harris Lake conditions monitored during the pre-operational and operational stages for the HNP included the following:

- The automatic and continuous daily collection and evaluation of lake levels within the Main Reservoir and the Auxiliary Reservoir. Lake levels are monitored for plant operational considerations, including the requirement for a minimum lake level of 66 m (215 ft.) National Geodetic Vertical Datum of 1929 (NGVD29) for the Main Reservoir and 76 m (250 ft.) NGVD29 for the Auxiliary Reservoir. The HNP has collected lake level elevations since impoundment.

The existing database is sufficient to describe the hydrological conditions in Harris Lake, as presented in ER Subsection 2.3.1.2. The proposed pre-application monitoring includes, at a minimum, the continued collection of the mean daily stage for the Main Reservoir and the Auxiliary Reservoir. In addition, the monitoring will be coordinated with the data collection activities conducted for HNP to avoid duplicate efforts.

6.3.1.3 Groundwater

The pre-application hydrological monitoring program for groundwater is being used to support the assessment of site acceptability and to identify effects to the groundwater system that may result from construction and operation of HAR 2 and HAR 3. The available groundwater information was evaluated to determine if the existing database is sufficient to support the description of the groundwater system characteristics near the site (ER Subsection 2.3.1).

The initial investigation of the groundwater system, which occurred during the site preparation and construction activities for the HNP, included the following (Reference 6.3-002):

- Implementation of an extensive boring program at the HNP facility (station complex), Auxiliary Reservoir, Main Reservoir, Main Dam, and Auxiliary Dam sites to collect geological and hydrological data.

- Implementation of a piezometer and well installation program to collect information on aquifer characteristics and water levels at the HNP facility. Groundwater levels were monitored in 16 piezometers and 18 wells periodically from November 1979 through December 1980. However, many of these piezometers were destroyed during construction activities of the HNP.

The findings of the previous investigations were verified to the extent possible with a site investigation conducted at the HAR site during summer 2006 to characterize the regolith and bedrock. Eighty-three additional boreholes were advanced to further characterize the subsurface conditions at HAR 2 and HAR 3.

At each borehole, rotary drilling with standard penetration testing (SPT) was advanced through soil to the SPT refusal criteria depth (50 blows over 76 millimeters [mm] [3 in.]). Rock coring was then initiated, using double-tube wireline coring methods to the borehole termination depth. Borehole depths ranged from approximately 12 m (40 ft.) to more than 61 m (200 ft.) below ground surface (bgs).

In addition, a well survey and gauging event was conducted on June 6 and 7, 2006, at the HNP site to determine the status of the HNP monitoring wells and piezometers. Twenty-one additional monitoring wells were installed during the HAR site investigation to more accurately characterize the potentiometric surface, gradient, and flow pathways within the vicinity of HAR 2 and HAR 3. Nine nested well pairs (18 out of 21 wells) were installed during the investigation to determine the connectivity between the surficial and bedrock aquifers. Shallow monitoring wells were screened within the regolith directly above the residual soil/bedrock interface; deep monitoring wells were screened completely within the Newark Supergroup (upper Triassic Series) bedrock. All operable monitoring wells and piezometers within the area of the proposed Reactor Island were surveyed to North American Datum of 1927 (NAD27) horizontal and NGVD29 vertical survey datums. Groundwater gauging events were conducted quarterly (August 2006, November 2006, February 2007, and May 2007) to account for seasonal and long-term variations in water table elevations.

The pre-application hydrological monitoring for the HAR site implemented during the development of the HAR COLA is based on the following:

- Monitoring of water levels in the piezometers and wells quarterly to verify the effects of hydrostatic loading on groundwater flow direction, and to estimate the amount of water that may need to be controlled during the excavation activities.

Figure 6.3-1 presents the well and piezometer locations monitored during the pre-application hydrological monitoring program. The data collected are being used to define the background conditions at the time of the HAR COLA and groundwater-related design elevations.

6.3.2 CONSTRUCTION HYDROLOGICAL MONITORING PROGRAM

The objective of the construction hydrological monitoring program is to monitor and control potential effects caused by site preparation and construction. Effects and controls for anticipated construction effects are discussed in Section 4.2 of this ER.

6.3.2.1 Freshwater Streams

As discussed in Section 4.2, the construction-related effects to Buckhorn Creek are considered minimal, provided that the proper controls are implemented to minimize effects to Harris Reservoir. The proposed construction monitoring of

Buckhorn Creek will include continuation of the pre-application hydrological monitoring program.

6.3.2.2 Lakes and Impoundments

The construction hydrological monitoring program for Harris Lake has been designed to monitor anticipated effects from site preparation and construction, and to monitor potential effects arising from construction activities. As discussed in ER Chapter 4 (Environmental Impacts of Construction), the majority of the construction-related effects to Harris Lake are related to increased erosion and sediment transport (Section 4.2). A major element of the construction monitoring will be to monitor the amount of sediment deposited in Harris Lake as a result of construction activities.

The proposed construction monitoring will include, at a minimum, continuing the pre-application hydrological monitoring program and the collection of the following hydrological data:

- Mean daily flow discharged from the Main Reservoir and the Auxiliary Reservoir (namely through the dams).
- Bi-monthly current velocity, concurrent with thermal and chemical monitoring, measured at a depth of 1 m (3.3 ft.) from the surface using a "Marsh McBirney Flowmeter" (or equivalent instrument). (Figure 6.3-1 shows the locations.)
- Periodic bathymetric surveys are conducted to estimate the current volume of Harris Lake and sedimentation.

In addition, the amount of sediment deposited at the stormwater outfalls will be monitored to determine if a sufficient thickness of sediment has accumulated that would require removal after completing construction.

6.3.2.3 Groundwater

The construction hydrological monitoring program for groundwater has been developed to monitor potential effects from site preparation and construction. As discussed in Subsection 4.2.1.2, the major effect to the groundwater system will be related to the dewatering required for site preparation and the excavation of the HAR site to the proposed embedment depth of 12 m (40 ft.). Water levels from wells and piezometers used for the pre-application hydrological monitoring program will be measured at weekly intervals during the active construction period to monitor lateral depression in the groundwater surface caused by dewatering. In addition, as a precautionary measure during the construction process, settlement points will be established and monitored to protect existing structures from settlement or ground movement during the excavation activities. These points will be monitored daily, at a minimum, and critical points may be

monitored continuously. The data will be used to monitor for the potential of damage to the foundations of existing structures.

6.3.3 PRE-OPERATIONAL HYDROLOGICAL MONITORING PROGRAM

The pre-operational hydrological monitoring program will be designed to provide the baseline for evaluating hydrologic changes arising from the operation of the HAR site. Baseline data collected during this monitoring program will be used to assess the following:

- Alteration of surface water flow fields in the site vicinity.
- Alteration of groundwater flow.
- Effect of sanitary and chemical waste-retention methods on groundwater quality. (Section 6.6 provides water quality groundwater sampling locations and associated analytical parameters.)
- Alteration of sediment transport. (Section 4.2 describes water-related effects and controls associated with construction and subsequent pre-operational activities.)
- Alteration of floodplains or wetlands. (Section 4.3 describes ecological effects and controls associated with construction and subsequent pre-operational activities.)

6.3.3.1 Freshwater Streams

The pre-operational hydrological monitoring program for Buckhorn Creek will be a continuation of the monitoring conducted during the pre-application and construction hydrological monitoring programs. The program may be modified based on the evaluation of the pre-application and construction monitoring data collected from Harris Lake.

6.3.3.2 Lakes and Impoundments

Continued implementation of the pre-application monitoring will provide the data necessary to assess alterations of surface water flow fields in Harris Reservoir (namely the cooling loop), sediment transport, floodplains, or wetlands. The program may be modified based on the evaluation of the pre-application monitoring data and other information collected for the operation of HAR 2 and HAR 3.

6.3.3.3 Groundwater

Harris Reservoir will be used to meet the facility's water requirements and no groundwater will be used; therefore, there should not be a significant effect to the

groundwater system from the operation of the HAR site. However, pre-operational monitoring will be conducted to re-establish baseline conditions for groundwater levels and flow following the completion of the construction activities. The monitoring will consist of collecting water level measurements quarterly from wells and piezometers that remain after the HAR facility is constructed.

6.3.4 OPERATIONAL HYDROLOGICAL MONITORING PROGRAM

The operational hydrological monitoring program will be designed to establish the effects from the operation of HAR 2 and HAR 3 and detect any unexpected effects that arise from facility operation. The operational hydrological monitoring program is anticipated to extend pre-operational monitoring for the duration of the HAR 2 and HAR 3 operation. Modifications to the monitoring program (e.g., changes in monitoring stations or collection procedures) will be assessed regularly over the duration of the operational hydrological monitoring program.

6.3.4.1 Freshwater Streams

The specific procedures of the operational monitoring requirements of Buckhorn Creek are anticipated to be similar to the pre-application and pre-operational hydrological monitoring programs. The program may be modified based on data collected and consultations with the NCDENR and the HNP. The data will be evaluated to monitor for changes in the discharge from Harris Reservoir to Buckhorn Creek.

6.3.4.2 Lakes and Impoundments

The operational hydrological monitoring program for Harris Lake will be designed to identify effects of the operation of HAR 2 and HAR 3. Specifics related to the operational monitoring are anticipated to be similar to the specifics for the pre-application and pre-operational hydrological monitoring programs. The operational hydrological monitoring program for Harris Lake will also include the collection of the hydrological data, if any, for automatic daily flow, which is discharged to the Main Reservoir from the proposed Cape Fear River makeup water system.

In addition, the monitoring may be modified based on consultations with the NCDENR and the HNP. The data from this monitoring program will be evaluated to determine changes in the cooling system flows, water levels in Harris Reservoir, and discharges from Harris Reservoir to Buckhorn Creek.

6.3.4.3 Groundwater

A limited operational hydrological monitoring program will be implemented to establish the effects to the groundwater system from the operation of HAR 2 and HAR 3, and to detect any unexpected effects from facility operation. The objective of the monitoring is to evaluate changes to the groundwater system

related to potential changes in Harris Reservoir levels. The monitoring of groundwater levels will consist of extending pre-operational monitoring for the duration of the HAR 2 and HAR 3 operation. The need for modifications to the monitoring program (e.g., changes in monitoring stations or frequency of collection) will be assessed regularly over the duration of the operational hydrological monitoring program.

6.3.5 REFERENCES

6.3-001 U.S. Geological Survey, "Monitoring Station: 02102192 Buckhorn Creek NR Corinth, NC," Website, waterdata.usgs.gov/nc/nwis/nwisman/?site_no=02102192&agency_cd=USGS, accessed January 18, 2007.

6.3-002 Carolina Power & Light Company, "Shearon Harris Nuclear Power Plant Units 1, 2, 3 & 4, Environmental Report Operating License Stage," Amendment 4, January 29, 1982.

6.4 METEOROLOGICAL MONITORING

The meteorological monitoring program will remain consistent throughout the site preparation through operational phases of HAR 2 and HAR 3. Therefore, the meteorological monitoring program section is not separated by project phase.

6.4.1 GENERAL DESCRIPTION — ON-SITE METEOROLOGICAL MONITORING PROGRAM

The on-site meteorological measurement program at the HNP began in March 1973 with the installation of a 61.4-m (201.4-ft.) guyed, open-latticed tower (Reference 6.4-001). The tower has been used to monitor meteorological parameters at two levels above ground level. It has operated continuously since being installed. Table 6.4-1 shows the current elevations of the operational sensors for all monitored parameters at both the lower and upper monitoring levels. Figure 6.4-1 shows a topographical map of the area and the location of the meteorological tower with respect to the HNP and the HAR.

The HNP meteorological tower is ideally situated for use in support of the HAR COLA. The tower is located approximately 1.6 km (1 mi.) east-northeast of HAR 2 and HAR 3, as shown in Figure 6.4-1. The monitoring results obtained from the tower will be used to characterize the on-site meteorological conditions for the HAR.

The topography surrounding the on-site meteorological monitoring tower is generally consistent with the terrain where HAR 2 and HAR 3 will be located. The area is grassy (based on site observations) and does not contain areas where undue radiational effects can affect the measurements in a manner not representative of the area. The tower is located approximately 1067 m (3500 ft.) from the proposed location of the nearest cooling tower for HAR 2 and HAR 3. The base elevation of the tower is 79 m (260 ft.) above mean sea level (msl) (Reference 6.4-002).

6.4.2 INSTRUMENTATION — 1973 TO CURRENT PERIOD OF OPERATION

The meteorological tower was installed and began operation in March 1973 in support of the development, construction, and operation of the HNP. The on-site tower, located northeast of the plant, consists of a 61.4-m (201.4-ft.) guyed, open-latticed design. The base elevation of the tower is 79 m (260 ft.) msl. An environmentally controlled shelter, which houses the system datalogger and remote access equipment, is located approximately 12 m (39 ft.) northwest of the tower. This shelter is perpendicular to the prevailing wind to minimize air-flow trajectory deviations.

The datalogger acquires signals from the meteorological sensors and stores 15-minute averaged values for each parameter. The memory has battery backup

to prevent loss of stored data during power outages. The information monitored on the tower is routinely accessed by way of the datalogger, downloaded, and archived remotely. The information is also available for display to the HNP control room operators (Reference 6.4-001).

6.4.2.1 Wind Systems

Lower level (12-m [39-ft.]) and upper level (61-m [200-ft.]) wind speeds are recorded by sensors mounted on 3.7-m (12-ft.) retractable booms oriented perpendicular to the prevailing wind flow (from the southwest to the northeast) to minimize tower shadow effects. Wind direction, wind speed, and wind direction variance (sigma theta) are monitored at both the lower and upper levels of the tower (Reference 6.4-001).

6.4.2.2 Temperature Systems

The ambient temperature and delta temperature parameters are monitored at both the lower and upper levels of the tower. Dew point temperatures are monitored at the lower level only. Two channels of differential temperature are monitored simultaneously between the lower and upper levels. The temperature and dew-point temperature probes are mounted in aspirated shields attached to a 2.4-m (8-ft.) retractable boom (Reference 6.4-001).

Dew point temperatures have historically been measured at the lower level of the tower, including during the period of record used to characterize the site, as described in ER Subsection 2.3.2. Dew point measurements made during this period of record were made consistent with the requirements of American National Standards Institute/American Nuclear Society (ANSI/ANS) 2.5-1984. However, the current meteorological monitoring system measures relative humidity at the lower level of the tower consistent with the accuracy requirements of NRC Regulatory Guide 1.23, Revision 1, as described in Table 2.3.3-202. Regulatory Guide 1.23, Revision 1 also indicates that "…atmospheric moisture measurements may be made at the highest measurement level on the meteorological tower." The existing natural cooling tower height at HNP is 158 m (520 ft.), which is far in excess of the meteorological tower height of 61 m (200 ft.). Given this difference, along with the expectation that the influence of cooling tower plumes will not be observed within 61 m (200 ft.) of ground level at the location of the meteorological tower, atmospheric moisture measurements have not been performed at the upper level of the meteorological tower.

6.4.2.3 Precipitation and Solar Radiation Systems

Precipitation and solar radiation are monitored near ground level by sensors near the base of the tower (Reference 6.4-001).

6.4.2.4 Maintenance and Calibration

The system datalogger and remote access equipment is checked and calibrated on a routine basis in accordance with NRC requirements. Accumulated system data are routinely analyzed for inconsistent or erratic data, including comparisons with appropriate meteorological data obtained from other local or regional meteorological observing stations.

The following maintenance and calibration program achieves the required level of system reliability (i.e., annual data recovery targets) (Reference 6.4-001):

- Calibrate datalogger input channels semi-annually.
- Calibrate or replace wind sensors with NIST-traceable calibrated sensors semi-annually.
- Calibrate the precipitation monitoring device (rain gauge) semi-annually.
- Calibrate or replace barometric pressure, dew-point temperature, and solar radiation channel sensors with NIST-traceable calibrated sensors annually.
- Monitor ambient/differential temperature channels for possible deviations. The temperature sensors are thermistors purchased with NIST-traceable calibration documentation. Thermistors are inherently stable (100-month drift less than 0.01°C and do not require routine sensor calibration or replacement. Deviation between the lower and upper ambient/differential temperature channels provides an early warning of a potential problem with one of these channels.

Accumulated system data are routinely analyzed and compared to appropriate alternative weather data sources, which provides an opportunity to screen for erratic or inconsistent data.

6.4.2.5 Data Reduction

Data from the HNP datalogger system are retrieved by way of a remote connection through a dial-up telephone link. If the primary telephone line is inoperable, a second dedicated telephone line is also available for data retrieval. Using its host computer, an off-site meteorological consultant retrieves the meteorological data from the HNP datalogger on a daily basis (except weekends and holidays). The retrieved data are reviewed for potential immediate problems and then checked for consistency with data obtained from the nearby Raleigh-Durham National Weather Service observing station. Erroneous data are discarded before insertion into the historical site database. The edited and reviewed 15-minute averaged data are then stored on electronic media.

The routine computer outputs include the following information (Reference 6.4-001):

- Data summaries listing maximum temperature, minimum temperature, average temperature, barometric pressure, precipitation, solar radiation, and dew-point temperature as daily and monthly averages.

- Hourly totals of precipitation, and hourly averages of barometric pressure, ambient temperature, differential temperature, dew-point temperature, upper- and lower-level wind direction and wind speed, upper- and lower-level wind direction variance (sigma theta), Pasquill stability classes (as calculated in accordance with a procedure outlined in the NRC Regulatory Guide 1.23 computed from the average of the two delta temperature systems, and accumulated solar radiation (langlies per minute).

- Fifteen-minute averages of all parameters except precipitation, which is displayed as a 15-minute total value.

- Joint wind frequency distributions (as outlined in the NRC Regulatory Guide 1.23) for both upper- and lower-levels showing average wind speeds and number of unrecovered data hours.

6.4.2.6 Accuracy of Measurements

Table 6.4-2 summarizes the accuracy of the measurements of the monitored parameters and the criteria upon which the accuracies are based (Reference 6.4-001). In general, the accuracy of the meteorological monitoring system during the 5-year period of record of on-site data described in Subsection 2.3.2 was consistent with the requirements of NRC Regulatory Guide 1.23, Revision 0, with the exception of the dew point temperature measurements, which met the requirements of ANSI/ANS 2.5-1984. The current monitoring system is compliant with the requirements of NRC Regulatory Guide 1.23, Revision 1.

6.4.3 REFERENCES

6.4-001 Carolina Power & Light Company, “Shearon Harris Nuclear Power Plant Final Safety Analysis Report,” Amendment 53, 1983.

6.4-002 Carolina Power & Light Company, “Shearon Harris Nuclear Power Plant Units 1, 2, 3 & 4, Environmental Report Operating License Stage,” Amendment 4, January 29, 1982.

Table 6.4-1
HNP Meteorological Monitoring Tower
Meteorological Sensor Elevations

Sensor	Elevation Above Tower Base (meters)
Wind Speed and Direction	12.5 and 61.4
Dew Point	11.0
Solar Radiation	1.5
Ambient Temperature (two at each level)	11.0 and 59.9
Delta Temperature (two channels)[a]	11.0 and 59.9
Precipitation	1.5
Barometric Pressure	1.5

Notes:
a) Used to measure differential temperature channel between these elevations.

Source: Reference 6.4-001

Table 6.4-2 (Sheet 1 of 2)
HNP Meteorological Monitoring Tower
Accuracy of Monitored Parameters [(a)]

Monitored Parameter	Basis	Accuracy Criteria
Wind Sensor:		
Wind Direction	NRC Regulatory Guide 1.23, Revision 1	±5 degrees (°). Starting threshold <0.45 meter per second (m/s) (1 mph). Resolution to 1.0°.
	NRC Regulatory Guide 1.97, Revision 3	Range: 0° to 360° ±5° accuracy with a deflection of 10°. Starting threshold less than 0.4 m/s (1 mph). Damping ratio greater than or equal to 0.4. Delay distance less than or equal to 2 mm (6.6 ft.)
Wind Speed	NRC Regulatory Guide 1.23, Revision 1	±0.2 m/s (±0.45 mph) or 5% of observed wind speed. Starting threshold <0.45 m/s (1 mph). Resolution to 0.1 m/s or 0.1 mph.
	NRC Regulatory Guide 1.97, Revision 3	Range: 0 to 44 m/s (100 mph); ±0.2 m/s (0.5 mph) for speeds less than 2 m/s (5 mph); ±10% for speed in excess of 2 m/s (5 mph). Starting threshold of less than 0.4 m/s (1.0 mph). Distance constant not to exceed 2 m (HNP Exception: Distance constant for installed instrument is 2.1 m).
Ambient Temperature	NRC Regulatory Guide 1.23, Revision 1	±0.5°C (±0.9°F). Resolution to 0.1°C (0.1°F).
Differential Temperature	NRC Regulatory Guide 1.23, Revision 1	±0.1°C (±0.18°F). Resolution to 0.01°C (0.01°F).
	NRC Regulatory Guide 1.97, Revision 3	±0.15°C per 50 m (±0.3°F per 164 ft.) for time-averaged values.
Wet-Bulb Temperature	NRC Regulatory Guide 1.23, Revision 1	±0.5°C (±0.9°F). Resolution to 0.1°C (0.1°F).
Relative Humidity/Dew Point	NRC Regulatory Guide 1.23, Revision 1	Relative Humidity: ±4% Resolution to 0.1%.
		Dew Point: ±1.5°C (±2.7°F). Resolution to 0.1°C (0.1°F).

Table 6.4-2 (Sheet 2 of 2)
HNP Meteorological Monitoring Tower
Accuracy of Monitored Parameters[a]

Monitored Parameter	Basis	Accuracy Criteria
Relative Humidity/Dew Point *(Continued)*	ANSI/ANS 2.5-1984[b]	Equivalent to Dew Point Accuracy of 1.5°C where relative humidity is in excess of 60% and temperature is between -30°C and +30°C. Resolution to 0.1°C.
Total Precipitation	NRC Regulatory Guide 1.23, Revision 1	Precipitation (water equivalent). ±10% for a volume equivalent to 2.54 mm (0.1 in.) of precipitation at a rate <50 millimeters per hour (mm/hr) (<2 inches per hour [in/hr]). Resolution to 0.25 mm (0.01 in.)
	ANSI/ANS 2.5-1984	Resolution of 0.25 mm (0.01 in.); ± 10% of total amounts > 0.2 in.
Solar Radiation	ANSI/ANS 2.5-1984	Consistent with current state-of-the-art.
Barometric Pressure	ANSI/ANS 2.5-1984	Consistent with current state-of-the-art
Time	NRC Regulatory Guide 1.23, Revision 1	±5 minutes (min.) Resolution to ±1 min.

Notes:
a) The HNP meteorological parameters monitored on the tower satisfy the indicated criteria, with exceptions as noted. Parameter accuracy based on NRC Regulatory Guide 1.23, Revision 1 and NRC Regulatory Guide 1.97, Revision 3 are base HNP commitments, while the American National Standards Institute/American Nuclear Society (ANSI/ANS) 2.5-1984 guidance reflects industry and regulator-accepted state-of-the-art specifications.

b) There are no accuracies specified in RG 1.23 for these parameters. ANSI/ANS 2.5-1984 guidance reflects industry and regulator-accepted state-of-the-art specifications.

m/s = meters per second
mph = miles per hour

Source: Reference 6.4-001

6.5 ECOLOGICAL MONITORING

This section describes the ecological monitoring program used to support the COL for HAR 2 and HAR 3.

In accordance with the NRC "Standard Review Plan" (NUREG-1555), ecological monitoring programs cover elements of the ecosystem for which a causal relationship between sensitive areas and species at the HAR site may be monitored during pre-application, site preparation, construction, pre-operation, and operation.

The ecological monitoring program generally comprises two subsets, terrestrial monitoring and aquatic ecosystem monitoring, each detailed throughout the four phases of the HAR:

- **Pre-Application Monitoring**. This phase was designed to establish background conditions, provide appropriate information on principal ecological features of the site, and determine if the data are adequate to support the existing environmental descriptions presented in ER Section 2.4.

- **Site Preparation and Construction Monitoring**. This phase builds on the existing pre-application monitoring program data and is designed to ensure that monitoring activities are adequate for preventing or controlling anticipated effects from site preparation and facility construction activities.

- **Pre-Operational Monitoring**. This phase is a logical extension of the pre-application and site preparation and construction monitoring programs. If important effects are identified during site preparation and construction, the effects can be reduced to acceptable levels by selecting an appropriate mitigation procedure, revising facility design, or modifying operating procedures.

- **Operational Monitoring**. This monitoring phase continues the studies conducted during the prior monitoring programs, enhancing the program with specific permit requirements as the additional two reactors become operational.

In an effort not to duplicate monitoring efforts, PEC will coordinate its ecological monitoring with existing ecological monitoring programs and efforts being performed by PEC, NCDENR, USEPA, North Carolina Wildlife Resources Commission (NCWRC), and other applicable groups or agencies. Any proposed ecological monitoring would be implemented at an appropriate time, in regards to the commencement of proposed site preparation or construction activities. Monitoring will span the period of pre-application through the operational phases of the HAR site.

During each phase of the project, results of the previous monitoring program will be reviewed periodically to ensure that monitoring efforts are sufficient. Modifications will be made to the program, as needed, based on the data results. If outputs of a preceding phase of the program demonstrate no significant effects, provisions to study such effects in successive monitoring programs will be reduced or eliminated.

The following subsections present information regarding ecological monitoring for terrestrial ecology, land use, and aquatic ecology of the HAR site; the vicinity, transmission corridors, off-site areas, and the region likely to be affected by site preparation and construction activities; pre-operation; and operation of the HAR facility, as detailed in Tables 6.5-1 and 6.5-2. Additional information on specific permit requirements is outlined in Table 1.2-1 of ER Chapter 1.

It is important to note that monitoring may yield results showing positive changes in the aquatic ecology. A larger aquatic habitat will be created, and thus benefits are likely for aquatic species and waterfowl.

6.5.1 TERRESTRIAL ECOLOGY

This section presents information regarding the monitoring of terrestrial ecosystems, as required in support of the HAR COLA. The approach for the design and execution of the HAR Terrestrial Monitoring Program is in accordance with the NRC's "Terrestrial Environmental Studies for Nuclear Power Stations" (Regulatory Guide 4.11), incorporating baseline ecological surveys, existing environmental information, potential contaminant exposure pathway analyses, and other data collected during previous studies. Surveys to monitor soil and terrestrial plant and animal communities will be conducted, as needed, to supplement the existing program. Generally, data are collected on a seasonal basis and should be sufficient for characterizing seasonal variations throughout at least one cycle. Additional data may be needed on a site-specific basis, or as directed by appropriate permit requirements.

The magnitude of sampling will be commensurate with the degree of expected or anticipated effects. The individual sampling elements of each program (e.g., vegetation, small mammal, amphibians and reptiles, game birds or mammals, special status flora and fauna) will be carefully evaluated to balance the effects of sampling against the benefits.

The proposed monitoring program is designed to document changes in plant and animal species composition over time and builds on the database gathered during the HNP preliminary baseline environmental assessment and monitoring. Any new ecological monitoring will be designed to collect data of the necessary quality at the appropriate times and according to an approved sampling design to achieve the goals of the ecological monitoring plan for the HAR site. Data quality objectives (DQOs) will be developed following guidance of USEPA and PEC's QA/QC Program (Reference 6.5-001).

Data collection may involve the appropriate qualitative and quantitative studies and statistical analyses. Determinations regarding the necessary studies, and the design of biological parameters of such studies, will be made following discussions with the appropriate agencies during agency consultation and permitting phases of the project.

Baseline ecological data were collected and presented in accordance with the NRC Regulatory Guide 4.2, Rev. 2, “Preparation of Environmental Reports for Nuclear Power Stations.” In accordance with the NRC Regulatory Guide 4.7, Rev. 2, “General Site Suitability for Nuclear Power Stations,” ecological systems and biota at the HAR site have been sufficiently identified and discussed to allow reasonably certain predictions that there will be no significant effects to the terrestrial ecology associated with the construction or operation of HAR 2 and HAR 3. Important species and ecological systems were identified and mitigation measures discussed for preventing any deleterious effects on these resources.

The proposed terrestrial monitoring plan for HAR 2 and HAR 3 will include these existing survey data as a baseline, conducting additional monitoring, as appropriate, to enhance and supplement the program. If outputs of a preceding monitoring program demonstrate no significant effects, modifications may be made to subsequent monitoring programs to reduce or eliminate provisions, as allowed by permits or through discussions with applicable agencies.

Construction practice control coupled with systematic inspection is usually sufficient to ensure protection of natural populations or ecosystems, but sometimes biological monitoring of important species is necessary. In such cases, it is reasonable that studies be designed to document effects and develop possible corrective actions, as directed in the NRC Regulatory Guide 4.11.

6.5.1.1 Pre-Application Terrestrial Monitoring

Information from pre-application monitoring will be used to assess site suitability and identify and evaluate potential effects to the terrestrial environment that could result from construction or operation of HAR 2 and HAR 3. These data are determined to be adequate for supporting the environmental description requirements of NUREG-1555, Environmental Standard Review Plan (ESRP) 2.4.1. The data are sufficient to characterize seasonal variability throughout at least one annual cycle, and additional data were collected on a site-specific basis. Data collection adequately covered the distribution and abundance of important species and habitats, including parameters such as critical life history information (e.g., feeding areas, nesting patterns, wintering areas, and migration routes), and descriptions of any modifications that will contribute to the existing patterns of plant and animal communities (e.g., modifications to Harris Reservoir, development of transmission lines, corridors, and access routes).

6.5.1.1.1 HAR Site

Pre-application field investigations conducted in August 2006 indicated the current HAR site is highly developed and consists of buildings, pavement, and maintained lawns. Little natural habitat remains. Small, fragmented woodlots are present in the industrial part, but limited habitat is available. One of the proposed reactor sites (HAR 2) is on mowed lawn with no other vegetation present. The other proposed reactor site (HAR 3) is in an area recently clear-cut and replanted with loblolly pine. The young pines are less than 10 years old, and there is substantial herbaceous vegetation growing among them. These areas are devoid of rare plants and are not desirable wildlife habitat (Reference 6.5-002).

No areas designated by the U.S. Fish and Wildlife Service (USFWS) as “critical habitat” are found at the site (Reference 6.5-003).

There are no federal, state, or regional land use plans for this area (ER Subsection 2.2.3). Construction at the site and vicinity will primarily affect Wake County. The westernmost portion of Wake County is primarily residential with some office/research park and industrial uses along U.S. Highway 1. The area west of the project site is located in Chatham County, which is zoned for heavy industrial use and office and institutional use along U.S. Highway 1 and Old U.S. Highway 1, which is surrounded by low density residential/agricultural use areas. The drainage area consists of mostly rolling hills with land used primarily for forestry and agriculture; the conversion of areas from forestry or agricultural purposes to residential uses continues in many parts of the drainage area.

6.5.1.1.2 Harris Reservoir Perimeter

The perimeter of Harris Reservoir is heavily wooded. A recent land use coverage analysis indicates that more than 70 percent of land in the watershed is forested (Reference 6.5-004). The perimeter of Harris Reservoir will be logged during construction in preparation for the increase in the water level; therefore, construction monitoring around the reservoir with respect to runoff and sediment transport will be very important.

Self-assessments were conducted in the past by the HNP and Carolina Power & Light Company (CP&L) to determine species composition and relative abundance within the HNP vicinity. Baseline surveys indicate that local mammals include white-tailed deer, bobcat, Virginia opossum, raccoon, eastern cottontail rabbit, gray squirrel, red and gray fox, eastern mole, skunk, shrew, and mouse. Amphibians include toads and frogs (Reference 6.5-005).

A pre-application field investigation was conducted in August 2006 to characterize habitats occurring between elevations of 67.1 and 73.2 m (220 and 240 ft.) surrounding Harris Reservoir. These habitat areas were characterized and designated as the baseline to determine probable effects from raising the elevation of the reservoir. Survey data indicated that the upland and wetland habitats support a variety of wildlife species. Buffers and wetland areas around

the perimeter will change as the water level rises, potentially affecting large and small mammals, reptiles, amphibians, and both migratory and nonmigratory birds (Reference 6.5-002).

6.5.1.1.3 Important Habitat

According to NUREG-1555, "important habitats" include any wildlife sanctuaries, refuges, or preserves; habitats identified by state or federal agencies as unique, rare, or of priority for protection; wetlands and floodplains; and land areas identified as critical habitat for species listed as threatened or endangered by the USFWS.

Previous surveys indicate that the forest communities along the perimeter of Harris Reservoir include three environmentally sensitive areas (i.e., North Carolina Natural Area Inventory Sites) designated as natural areas by the NCDENR (Reference 6.5-004). These areas include Hollemans Crossroads slopes, Utley Creek slopes, and Jim Branch/Buckhorn Creek Forests (Figure 2.4-4 in ER Subsection 2.4.1.2.3). Although these areas are not under mandatory protection, potential effects to the areas would be minimized and monitoring will be conducted on a periodic basis to identify any adverse effects resulting from construction or operation of the HAR facility. It is expected that these areas will stabilize within 3 to 5 years after reservoir clearing and filling; any post-operational monitoring of these areas will be determined after discussions with North Carolina National Heritage Program (NCNHP).

North Carolina State University uses the Harris Research Tract, a 512.74 hectares (ha) (1267 acre [ac.] or 1.98 mi.^{2}) parcel of PEC land near the HAR site, for long-term forest research (Reference 6.5-006). An experimental population of Michaux's sumac, federally and state-listed as endangered, was transplanted there in 2001 and is being monitored by biologists from North Carolina State University (Reference 6.5-003). HAR operations are not expected to adversely affect this area; therefore, no specific monitoring program has been developed for this area.

PEC enrolled 5352.79 ha (13,227 ac. or 20.67 mi.^{2}) within the region around the HAR site in the NCWRC Game Lands Program (Reference 6.5-007). These properties are known collectively as the Shearon Harris Game Lands, and PEC allows the public to hunt deer, turkey, small game, and waterfowl within the region. Because of the distance from the site, these areas are not expected to be adversely affected by construction or operation of the HAR facility. Therefore, no specific monitoring programs have been designed to address effects to these areas.

6.5.1.1.3.1 Wetlands and Floodplains

Potential wetland impacts were assessed using a desktop evaluation and limited wetland field reconnaissance in 2006 (Reference 6.5-002). A more detailed delineation and mapping was initiated in 2008 and completed in December 2009

(Reference 6.5-030). USACE approved the Jurisdictional Determination in October 2010. This effort included a survey of areas that would be impacted by raising the current operating surface water elevation of 67.1 m (220 ft) to 73.2 m (240 ft) NGVD29. A total of 244 ha (603 ac) of wetlands would be flooded by raising the elevation of Harris Reservoir. This would include 76 ha (188 ac) of forested wetlands, 0.9 ha (2.2 ac) of herbaceous wetlands, 138 ha (341 ac) of emergent wetlands, 2 ha (5 ac) of open water wetlands, and 26 ha (64 ac) of vegetated fringe wetlands. These wetlands are discussed in ER Subsection 2.4.2.2 (Reference 6.5-002)

6.5.1.1.3.2 Historic Properties

Before the HNP was constructed, the University of North Carolina conducted an archaeological investigation of the HAR site in late fall 1978, focusing on the area to be affected by plant construction and the area targeted for the planned reservoir (ER Subsection 4.1.3). Thirty-six prehistoric sites and one historic site were discovered. The sites were mostly occupied by the people of the middle and late Archaic periods, consisting of migratory bands of hunters that left artifacts similar in nature across North Carolina and the southeast (Reference 6.5-008).

PEC's archaeological consultant, New South Associates, conducted an archaeological reconnaissance and geomorphological investigation of the inundation area around Harris Reservoir. The investigations included a map and literature review, and the excavation of 19 backhoe trenches in areas with high potential for deeply buried cultural strata. The investigations were successful in verifying the potential for deep sites in certain areas and in demonstrating that only high energy, modern deposits were present in other areas (Reference 6.5-009).

To comply with state requirements, PEC also contracted New South Associates in 2006 to conduct an archaeological survey of a proposed water makeup line corridor from the Cape Fear River to Harris Reservoir. The survey included background research, site discovery through shovel testing at 30-m (98-ft.) intervals, surface surveys, site delineation, analysis, and reporting (ER Subsection 4.1.3). It was determined that the proposed water makeup line will not affect any resources listed in, nominated to, or eligible for the National Register of Historic Places (NRHP). No further work is warranted, and clearance to construct is recommended (Reference 6.5-010).

According to the ESRP regulations, when new transmission lines and corridors are planned, data and information on historic properties within 1.9 km (1.2 mi.) of the proposed corridor are required. Planning efforts associated with the three new transmission lines will take into consideration existing historic properties and include consultation with the State Historic Preservation Office (SHPO).

6.5.1.1.3.3 Species of Interest

According to NUREG-1555, “important species” are defined as federally or state-listed (or proposed for listing) threatened or endangered species, commercially or recreationally valuable species, species essential to the maintenance and survival of species that are rare and commercially or recreationally valuable, species critical to the structure and function of the local terrestrial ecosystem, or species that will serve as biological indicators for monitoring the effects of the facilities on the terrestrial environment.

No areas within the HAR site are designated by the USFWS as critical habitat for federally threatened or endangered species, but surveys will be required in sensitive habitats before site preparation or construction activities. Three federally listed, candidate, or recently delisted species (bald eagle, red-cockaded woodpecker, and Michaux’s sumac) were confirmed in the vicinity of the HAR site in recent years (Reference 6.5-003). The southeastern bat (Myotis) is a federal species of concern that may migrate through the HAR site (Reference 6.5-011).

A pre-application site investigation was conducted in August 2006 to observe avian habitat and species abundance occurring between the elevations of 67.1 and 73.2 m (220 and 240 ft.) surrounding Harris Reservoir; no species of interest were observed during this survey (Reference 6.5-002).

Neotropical songbirds typical of the Carolina Piedmont region likely live within wooded habitats throughout the site, as do predatory and scavenging birds. Raptors routinely migrate through the inland eastern United States (Section 2.4). CP&L/HNP conducted self-assessments in the past to determine species composition and abundance of bird species in the area during migratory and nesting periods. The survey methodology included both visual sight counts and auditory censuses (Reference 6.5-003). Bird surveys were also performed by local groups in nearby areas (Jordan Reservoir and Raleigh) (Reference 6.5-012).

The recently delisted bald eagles are occasionally seen around Harris Reservoir. An active bald eagle nest was discovered near Harris Reservoir during the 2004 and 2005 nesting season. Located on private property, the nest is slightly north of State Road 1130 and approximately 610 m (2000 ft.) from the shoreline of the White Oak Creek arm of the reservoir (Reference 6.5-003). It is unlikely that red-cockaded woodpeckers would be affected by site expansion, but precautions would be taken before timber removal to ensure the species has not relocated to the area and could be affected by logging. Golden eagles have also been observed within the HAR vicinity. Additional migratory species may also be susceptible to effects from disturbance during periods when they use the HAR site. The USFWS will be contacted to confirm the presence or absence of any federally listed (or proposed for listing) threatened or endangered animals before commencement of site preparation or construction activities.

6.5.1.1.3.4 Species of Commercial or Recreational Value

PEC follows the best management practices (BMPs) of the NCDENR, Division of Forest Resources. BMPs implemented at the HAR site include establishment of streamside management zones and of buffer strips of vegetation adjacent to perennial and intermittent streams and water bodies (Reference 6.5-003). The monitoring programs previously discussed are adequate for monitoring the composition and abundance of these species during construction and operation periods; therefore, no additional monitoring is proposed for this area.

6.5.1.1.4 Cape Fear River Intake Structure and Pumphouse

Harris Reservoir and the proposed facilities along the Cape Fear River are located in an area where the Piedmont transitions to the coastal plain. As defined by Schafale and Weakley, vegetation in this area generally can be characterized as Piedmont bottomland forest or Piedmont swamp forest (Reference 6.5-013).

Swamp forest communities generally have canopies dominated by flood-tolerant species such as sweetgum, American elm, and various species of oak. These swamp forest communities typically have lower diversity than other communities, containing only those species most tolerant of prolonged wet conditions. Piedmont bottomland forest communities generally have canopies dominated by tulip poplar, sweetgum, cherrybark oak, sugarberry, and green ash (Reference 6.5-013).

The discharge canal has vegetation typical of the riparian corridor along the Cape Fear River and has largely remained undisturbed for a number of years (Reference 6.5-014).

6.5.1.1.4.1 Important Habitat or Species of Interest

The federally endangered Cape Fear River shiner is endemic to several tributaries of the Cape Fear River. The Carolina redhorse may be present in the Cape Fear River (undetermined at this point) (ER Subsection 4.3.2.3.3) (Reference 6.5-015). If either species is detected at any time during construction or operational periods, the appropriate resource agencies will be consulted to determine the necessary protective measures (Subsection 6.5.2.1.3).

6.5.1.1.5 Makeup Water Pipeline Corridor

The corridor will be located in an area near the Harris Reservoir perimeter habitat, and is addressed in ER Subsection 2.4.1.2. Biologists evaluated the area in August 2006 to assess resources along the proposed corridor for the makeup water pipeline. The proposed pipeline right-of-way (ROW) crosses two primary habitat types: old field community and forest. The existing transmission line right-of-way (ROW) was cleared of woody vegetation beyond the sapling stage and is regularly maintained as an old field community (Reference 6.5-002).

6.5.1.1.5.1 Important Habitat or Species of Interest

Potential receptors and target species for monitoring are similar to those listed previously; however, additional monitoring may be needed, because this corridor also crosses NCWRC Game Lands. Furthermore, several species of interest including the red-cockaded woodpecker, Carolina grass-of-parnassus, eastern tiger salamander, and four-toed salamander are known to occur along or near the corridor (Reference 6.5-003).

6.5.1.1.6 Transmission Lines

The three new transmission lines and associated switchyard for HAR 3 will be developed, as described in ER Section 3.7. Alterations and relocations would be conducted according to appropriate regulations and BMPs.

The eastern tiger salamander, which is state-listed as threatened, is known to reside approximately 91.4 m (300 ft.) from the Harris-Wake transmission corridor (Reference 6.5-002). The Harris-Wake transmission corridor would not be altered, and thus no effect to the eastern tiger salamander is expected.

PEC has procedures in place to protect endangered or threatened species if encountered along transmission corridors and provides training for employees on these procedures (Reference 6.5-016). Specific monitoring requirements will be designed to meet conditions of permits, minimize adverse environmental effects, and ensure that organisms are protected against transmission line alterations. The forest lands traversed by the transmission line corridor are described in ER Subsections 2.4.1.2.2.2 and 2.4.1.3.1. The agricultural lands are representative of agricultural lands throughout the region, and the establishment of the corridors has not significantly altered their use. As discussed in ER Subsection 4.3.1.5 transmission lines and transmission line corridors are maintained in accordance with established procedures to prevent encroachment on the lines. The removal of woody species can provide outstanding grassland and marsh habitat for many rare plant species dependent on open conditions.

6.5.1.1.6.1 Important Habitat or Species of Interest

The transmission corridors do not cross any state or federal parks, but do cross the NCWRC Game Lands that encircle the HAR site. Red-cockaded woodpeckers are known to occur in mature longleaf pine forests crossed by the Harris-Fayetteville transmission corridor. Carolina grass-of-parnassus, a state-listed endangered species, resides in wet savannahs on the Harris-Fayetteville transmission corridor (Reference 6.5-003). Precautions will be taken if Carolina grass-of-parnassus is identified in the area to be cleared.

No other federally or state-listed threatened or endangered terrestrial species are known to occur at the HAR site or along its transmission corridors. CP&L signed a Memorandum of Understanding with NCDENR to preserve and protect rare, threatened, and endangered species and sensitive natural areas within

transmission ROWs (Reference 6.5-016). BMPs for management of rare plants along transmission ROWs are also followed.

6.5.1.2 Site Preparation and Construction Monitoring

Construction monitoring will be required only when specific adverse effects are predicted and when conscientious construction practices coupled with system inspection are insufficient for preventing adverse effects. Monitoring will be based on specific permit requirements or agency discussions.

6.5.1.2.1 HAR Site

Site preparation and construction activities are not expected to reduce the local or regional diversity of plants or plant communities at the developed HAR site. The primary focus of site preparation and construction monitoring in this area will be related to runoff and sediment transport to adjacent areas, as required by state regulations and defined in the NPDES permit. Sedimentation is a primary adverse effect associated with both clearing and construction. Work will be conducted pursuant to Title 15 A-Chapter 4 of the North Carolina Administrative Code, the Erosion and Sedimentation Control Ordinance of Wake County, and the Chatham County Soil Erosion and Sedimentation Control Ordinance. An erosion and sedimentation control plan will be submitted to NCDENR Land Resources for approval, and a Land Disturbance Permit will be obtained from Chatham and Wake counties before work begins (ER Subsection 4.3.2.1.1).

6.5.1.2.2 Harris Reservoir Perimeter

The perimeter of Harris Reservoir will be logged during construction in preparation for the increase in the water level; therefore, construction monitoring around the reservoir with respect to runoff and sediment transport will be very important.

Erosion would be monitored and control measures established to minimize sediment deposition. Available safeguards, such as sediment basins, silting areas, and revegetation of disturbed areas would be implemented to minimize ecological effects to small animal populations. Specific monitoring requirements will be determined by the appropriate permits.

Prior to site preparation, a general survey around the perimeter of Harris Reservoir will be conducted to identify rare plants. The NCNHP and the North Carolina Native Plant Society will be consulted on the surveys and any necessary measures to minimize effects to populations of rare plants. Timber removal will consist of gradual clearing of the area in phases, to minimize the amount of exposed ground at any one time and allow for wildlife to emigrate from the disturbed sites. Site preparation and construction monitoring will be conducted periodically at specific monitoring stations surrounding Harris Reservoir to verify that controls are in place and that adjacent ecosystems are not being affected by timber removal. It may also be necessary to stabilize (seed)

the ground as quickly as possible following construction to prevent excessive erosion and subsequent sedimentation.

6.5.1.2.2.1 Important Habitat

Timber removal in the environmentally sensitive forest communities along the perimeter of Harris Reservoir would be as minimal as possible with extra precautions to conserve chalk maple and American lotus in the Hollemans Crossroads slopes. The Virginia spiderwort, a state-listed significantly rare herb, is present on several Utley Creek slopes (Reference 6.5-017). A blue heron rookery is present along the Jim Branch area (Reference 6.5-002). Although these natural areas are not under mandatory protection, they may be affected by construction or operation and require monitoring, as specified in the permits or designated by appropriate agencies. Before site preparation or construction work begins, surveys will be conducted in appropriate habitats where specific adverse effects are predicted to occur, requiring mitigation. Monitoring stations will be selected based on final designs and an evaluation of potential effects, following discussion with applicable agencies. These areas will be surveyed on a yearly basis during the construction period or as designated by agency discussion.

6.5.1.2.2.2 Wetlands and Floodplains

Although the land between the 67.1- and 73.2-m (220- and 240-ft.) contours will be cleared, clearing and construction will be conducted over a period of time (roughly 5 years) requiring the preservation of existing wetlands. Thus, precautions would be taken during the removal of timber to minimize effects to wetlands (such as with mats and barriers).

Before clearing and construction, wetlands within the 67.1- and 73.2-m (220- and 240-ft.) contours and any potentially affected wetlands above the 73-m (240-ft.) contour would be delineated in accordance with USACE guidelines and mitigation measures. All activities would be conducted in accordance with federal and state regulations, as well as applicable federal Clean Water Act (CWA) 404 or state CWA 401 wetland permit requirements, existing PEC procedures, and BMPs to minimize adverse effects to wetlands or aquatic wildlife (Reference 6.5-018). Specific monitoring requirements for construction and operation activities affecting wetlands and floodplains will be prescribed by the various permits and discussions with applicable agencies.

A survey will be required in the Harris Research Tract before site clearing and construction activities begin to ensure there is no effect to Michaux's sumac. If it is determined that this area may be affected, this tract will be surveyed on a yearly basis throughout the construction period.

Because of the distances from the site, the Shearon Harris Game Lands are not expected to be adversely affected by construction or operation of the HAR facility. Therefore, no specific monitoring programs have been designed to address effects to these areas.

Any land use effects to floodplains will be in accordance with Executive Order 11988, "Floodplain Management" (42 Federal Register [FR] 26951) and U.S. Water Resources Council, "Floodplain Management Guidelines" (43 FR 6030) (Reference 6.5-019).

6.5.1.2.2.3 Historic Properties

The SHPO indicated that areas affected by the new plant, intake structure, and intake pipeline would require a Phase I archaeological investigation (Reference 6.5-020). Part of the area around Harris Reservoir that will be inundated by an increase in the operating level of the reservoir will also require a Phase I archaeological investigation.

PEC will complete the Phase I investigation after the HAR COLA is submitted to allow more time for planning and budgeting. The Phase I archaeological survey will examine all high probability landforms through the excavation of screened shovel tests on a 30-m (98-ft.) interval. With low probability areas eliminated because of disturbance, slope, or modern stream dynamics, it is estimated that 498.17 ha (1231 ac. or 1.92 mi.^{2}) will require a high probability survey. In addition, 29.22 ha (72.2 ac. or 0.11 mi.^{2}) of alluvial settings have a potential for cultural strata below the reach of shovel testing; fifty 1-m by 1-m (9.8-ft. by 9.8-ft.) units will be excavated as an initial survey effort (Reference 6.5-009).

Although historic properties surveys were conducted on the project area before construction of the HNP facility and reservoir, additional areas will be affected by HAR 2 and HAR 3. Follow-up investigations, pursuant to Section 106 of the National Historic Preservation Act (NHPA), will be required to identify the full extent of historic properties adjacent to and within the project area (Reference 6.5-021).

PEC developed a policy consistent with the North Carolina General Statutes (G.S.) designed to protect historic properties (North Carolina G.S. Chapter 14, Article 22) and Section 106 of the NHPA (16 [U.S. Code] [USC] 470) to ensure the protection of known historic properties on PEC property (Reference 6.5-022 and Reference 6.5-023). The requirements state that a cultural resource assessment must be conducted for any project that will affect cultural resources (e.g., archaeological, historical, or architectural). The policy ensures appropriate identification of historic properties and consultation with the SHPO (Reference 6.5-020).

6.5.1.2.2.4 Species of Interest

Before site preparation or construction begins, surveys will be required to identify the presence of sensitive species, such as the bald eagle and red-cockaded woodpecker. Survey and sampling data will be collected periodically during site preparation and construction activities, and will be compared to baseline studies to determine changes in species composition and abundance.

An active bald eagle nest was reported in the 2004–2005 nesting season on private property near the Harris Reservoir (Reference 6.5-002). The elevation rise in the reservoir is not expected to adversely affect the bald eagle nesting area; however, precautions will be taken to avoid bald eagles during their reproductive season (March through April). These precautions include educating timber harvesters and limiting timber harvest near known nesting areas. Further precautions to protect bald eagles would be explored if nests were found within areas scheduled for construction.

It is unlikely that red-cockaded woodpeckers would be affected by site expansion, but precautions will be taken before timber removal to ensure that the species has not relocated to the area and could be affected by logging. During site preparation and construction activities, specific monitoring stations will be established and surveys conducted yearly in the area surrounding the Harris Reservoir for species of interest that may occur in or near areas of effect.

6.5.1.2.2.5 Species of Commercial or Recreational Value

PEC follows BMPs of the NCDENR, Division of Forest Resources for species of commercial or recreational value (Reference 6.5-003). These monitoring programs are adequate for monitoring the composition and abundance of these species during construction and operation periods; therefore, no additional monitoring is proposed for this area.

6.5.1.2.3 Cape Fear River Intake Structure and Pumphouse

Harris Reservoir and the proposed facilities along the Cape Fear River are located in an area where the Piedmont transitions to the coastal plain. As defined by Schafale and Weakley, vegetation in this area generally can be characterized as Piedmont bottomland forest or Piedmont swamp forest. (Reference 6.5-013)

Monitoring will be required in accordance with the NPDES permit during site preparation and construction to ensure that appropriate controls are in place to prevent sedimentation of the Cape Fear River.

6.5.1.2.4 Makeup Water Pipeline Corridor

The proposed pipeline ROW crosses two primary habitat types: old field community and forest. The existing transmission line ROW was cleared of woody vegetation beyond the sapling stage and is regularly maintained as an old field community (Reference 6.5-002). Specific monitoring requirements will be determined by the appropriate permits. A summary of monitoring requirements is shown in ER Table 6.5-1.

6.5.1.2.4.1 Important Habitat or Species of Interest

Potential receptors and target species for monitoring are similar to those listed previously for the Harris Reservoir; however, additional monitoring may be needed, as this corridor also crosses the NCWRC Game Lands. Furthermore, several species of interest including the red-cockaded woodpecker, Carolina grass-of-parnassus, eastern tiger salamander, and four-toed salamander are known to occur along or near the corridor (Reference 6.5-003). Specific monitoring requirements will be determined by the appropriate permits. A summary of monitoring requirements is shown in Table 6.5-1.

Monitoring during site preparation will be required to ensure disturbance is minimized and erosion control measures are in place as required by specific permit requirements, ensuring that runoff effects are minimized and restoration activities are adequate and effective.

6.5.1.2.5 Transmission Lines

Transmission lines and transmission line corridors are maintained in accordance with established procedures to prevent encroachment on the lines. The removal of woody species can provide outstanding grassland and marsh habitat for many rare plant species dependent on open conditions. Specific monitoring requirements will be determined by the appropriate permits. A summary of monitoring requirements is shown in Table 6.5-1.

6.5.1.2.5.1 Important Habitat or Species of Interest

The transmission corridors do not cross any state or federal parks, but do cross the NCWRC Game Lands that encircle the HAR site. Specific monitoring requirements will be determined by the appropriate permits. A summary of monitoring requirements is shown in Table 6.5-1.

Red-cockaded woodpeckers are known to occur in mature longleaf pine forests crossed by the Harris-Fayetteville transmission corridor. Site preparation and construction activities involving removal of mature longleaf pine along the corridor would require periodic surveys for this species to ensure that red-cockaded woodpeckers or cavity trees are not affected (Reference 6.5-003). PEC will consult with the USFWS and NCWRC on the appropriate monitoring methods if red-cockaded woodpeckers are encountered during any transmission line construction activities.

Carolina grass-of-parnassus, a state-listed endangered species, resides in wet savannahs on the Harris-Fayetteville transmission corridor (Reference 6.5-003). PEC will consult with the NCNHP and NCWRC on the appropriate mitigation measures if Carolina grass-of-parnassus is identified in the area to be cleared.

No other federally or state-listed threatened or endangered terrestrial species are known to occur along the current transmission corridors. CP&L signed a

Memorandum of Understanding with NCDENR to preserve and protect rare, threatened, and endangered species and sensitive natural areas within transmission ROWs (Reference 6.5-016). BMPs for management of rare plants along transmission ROWS are also followed.

6.5.1.3 Pre-Operational Terrestrial Monitoring

PEC intends to build on the approved pre-application and site preparation and construction monitoring programs, providing enhancement and expansion, as needed, to accommodate HAR 2 and HAR 3. If important environmental effects are identified during site preparation and construction, these effects can be reduced to acceptable levels by selecting an appropriate mitigation method, revising the facility design, or modifying operating procedures. The pertinent resource agencies will be consulted prior to implementing any mitigation or control methods.

This monitoring program will complement and integrate with other monitoring programs across the HAR site (e.g., hydrological monitoring, aquatic monitoring, and meteorological monitoring), and monitoring programs conducted by the HNP, NCDENR, USEPA, NCWRC, and other agencies to ensure data is consistent and comprehensive. Two or more years of consecutive data will be collected to ensure potential effects to ecological systems and biota at the HAR site have been sufficiently identified and mitigation measures implemented. The exact monitoring program schedule will be determined after consultation with the pertinent resource agencies.

Data collected during the pre-operational phase will be statistically sound and designed to provide a sufficient baseline. Adequate data will be provided during the pre-operational phase to allow assessment of drift and vapor plume effects on vegetation growth and habitat modification as it affects terrestrial organisms, avian collisions with towers and transmission lines, and effects on important species and habitats.

6.5.1.3.1 HAR Site

During the pre-operational phase, monitoring around the developed HAR site will consist of specific permit requirements, such as air and effluent monitoring, as required.

6.5.1.3.2 Harris Reservoir Perimeter

Pre-operational monitoring for the area surrounding Harris Reservoir will continue the studies conducted during site preparation and construction monitoring, and be specific to NPDES and CWA permit requirements.

Monitoring will consist of periodic surveying at designated sampling stations to determine and denote changes in species composition and abundance nearby, and to ensure controls are in place and working effectively.

Results of these surveys will be reported in PEC periodic monitoring reports. Sampling methodologies will continue with the generally accepted techniques of quadrant, quarter, and transect sampling. Additional monitoring would be in accordance with specific permit requirements or agency discussion.

6.5.1.3.3 Cape Fear River Intake Structure and Pumphouse

Monitoring required in accordance with the NPDES permit during site preparation and construction to prevent sedimentation of the Cape Fear River will continue during the pre-operational phase. Specific monitoring requirements will be determined by the appropriate permits. A summary of monitoring requirements is shown in ER Table 6.5-1.

6.5.1.3.4 Makeup Water Pipeline Corridor

Potential receptors and target species for continued monitoring during the pre-operational phase are similar to those listed for Harris Reservoir; however, additional monitoring may be needed because this corridor crosses the NCWRC Game Lands. Several species of interest, including the red-cockaded woodpecker, Carolina grass-of-parnassus, eastern tiger salamander, and four-toed salamander are known to occur along or near the corridor (Reference 6.5-007). Surveys will be conducted in this area periodically to ensure that there will be no adverse effects to these species' habitats.

6.5.1.3.5 Transmission Lines

Red-cockaded woodpeckers are known to occur in mature longleaf pine forests crossed by the Harris-Fayetteville transmission corridor. Periodic pre-operational surveys along the corridor may be required to ensure that red-cockaded woodpeckers or cavity trees are not affected (Reference 6.5-003). Specific monitoring requirements will be determined by the appropriate permits. A summary of monitoring requirements is shown in Table 6.5-1.

6.5.1.4 Operational Terrestrial Monitoring

Operational monitoring will continue the studies conducted during the pre-operational monitoring plan, and the program would be modified, as necessary, with any specific permit requirements as the additional two reactors become operational. The operational monitoring program will be designed and approved after consultation with the appropriate resource agencies to ensure any operational effects are addressed and that the program provides statistically valid and defensible data per PEC's QA/QC Program.

Data collected during the operation phase will be used to achieve the following goals:

- Monitor environmental conditions that could be related to the releases of contaminants from operation of the facilities.

- Monitor tissue concentrations in selected species as a means of identifying exposure pathways and early detection of potential problems.

6.5.1.4.1 HAR Site

Operational monitoring at the developed HAR site will consist of specific permit requirements, such as air and effluent monitoring.

6.5.1.4.2 Harris Reservoir Perimeter

Operational monitoring will continue the studies conducted during pre-operational monitoring, and be specific to the NPDES and CWA permit requirements.

Monitoring will be conducted per any requirements specified in the NPDES permit during the operational phase to ensure that appropriate controls are in place to prevent sedimentation of the Cape Fear River. The monitoring program will likely include major ecosystem components such as water quality and terrestrial and aquatic communities. The program elements will be determined through resource agency consultations and operating permit requirements.

Throughout operation of the HAR site, PEC personnel will comply with protocol specifically designed for endangered and threatened species (Reference 6.5-016). PEC will continue to work with the NCNHP and various agencies to protect and manage habitat for important species during operation of the HAR site.

6.5.1.4.3 Cape Fear River Intake Structure and Pumphouse

Monitoring required in accordance with the NPDES permit during the construction and pre-operational phases will continue in order to detect and prevent sedimentation of the Cape Fear River.

6.5.1.4.4 Makeup Water Pipeline Corridor

Target species, to include potential endangered and threatened species for continued monitoring during the operational phase, are similar to those listed for Harris Reservoir; however, additional monitoring will be needed for the NCWRC Game Lands. Specific monitoring requirements will be determined by the appropriate permits. A summary of monitoring requirements is shown in Table 6.5-1.

6.5.1.4.5 Transmission Lines

Operational monitoring will be conducted to comply with established procedures. Specific monitoring requirements will be determined after consultation with the

appropriate resource agencies and any stipulations outlined in issued permits. A summary of potential monitoring requirements is shown in Table 6.5-1.

6.5.2 AQUATIC ECOSYSTEM

This section describes the aquatic ecosystems monitoring program that will be used to support the COL for HAR 2 and HAR 3. In general, this program consists of the following primary elements:

- **Pre-Application Monitoring**. This phase of the monitoring was designed to establish background conditions and determine if the data were adequate to support the existing environmental descriptions presented in ER Subsection 2.4.

- **Site Preparation and Construction Monitoring**. This phase builds on the existing pre-application monitoring program data and is designed to ensure that monitoring activities are adequate to prevent or control anticipated effects from site preparation and facility construction activities.

- **Pre-Operational Monitoring**. This phase is a logical extension of the pre-application and site preparation and construction monitoring programs. If important effects are identified during site preparation and construction, these effects can be reduced to acceptable levels by selecting an appropriate mitigation method, revising facility design, or modifying operating procedures.

- **Operational Monitoring**. This monitoring phase continues the studies conducted during the prior monitoring programs, enhancing the program with specific permit requirements as the additional two reactors become operational.

The aquatic monitoring program for Harris Reservoir and associated streams has been developed to support and satisfy various environmental regulations, licenses, and permits associated with construction and operation. The program will build on more than 20 years of data collected by the HNP and the North Carolina DWQ monitoring (ER Subsection 2.4.2). Water quality will be carefully monitored at the locations expected to be affected the most by construction and operation of the HAR site, spillway, and makeup water pipeline outfall into Harris Reservoir. Monitoring will also occur in stream channels and parts of Harris Reservoir affected by construction of HAR 2 and HAR 3. Monitoring will be focused on construction activities to ensure effects are minimized and controls are maintained to minimize sedimentation.

During each phase of the HAR construction, results of the previous monitoring program will be reviewed periodically to ensure that the monitoring efforts are sufficient. Modifications will be made to the program, as needed, based on the data results and discussions with the permitting agency. If outputs of the preceding phase of the program demonstrate no significant effects, provisions to

study such effects in successive monitoring programs will be reduced or eliminated after discussions and approvals by agencies, if monitoring is required per permit requirements.

The HNP monitors the water quality of the Harris Main and Auxiliary Reservoirs to satisfy various environmental regulations, licenses, and permits associated with operation of the HNP. The HNP has also monitored water quality in the HNP vicinity since 1972 in support of the original development of the HNP facility. Information available from the monitoring programs includes 5 years of monitoring data before construction of the HNP (from 1972 to 1977), 9 years of water quality data during construction of the HNP (from 1978 through 1986), and roughly 20 years of data since the HNP began operation (from 1987 to the present).

In addition to the monitoring programs undertaken by the HNP, the DWQ performs monitoring of Harris Reservoir under the Ambient Reservoirs Monitoring Program (ER Subsection 2.4.2).

The proposed aquatic monitoring program for HAR 2 and HAR 3 is designed to overlap the proposed hydrological monitoring program to establish background conditions for surface water and groundwater before construction and operation (Section 6.3). Available hydrological and hydrogeological information was evaluated to determine if the data were sufficient to support the existing environmental descriptions presented in ER Subsection 2.3.1.

The data evaluation was based on the location and number of monitoring stations that consider such factors as bathymetric characteristics of Harris Reservoir, soil and groundwater system characteristics, type of cooling system to be employed and probable operating modes, transient hydrological parameters near the site, sampling frequency and times that document temporal variations, and duration of the various monitoring programs. Specific monitoring details for aquatic ecology at the HAR site are shown in Table 6.5-2.

6.5.2.1 Pre-Application Monitoring

6.5.2.1.1 HAR Site

No adverse long-term quality or aquatic ecological effects are expected on the developed HAR site. The primary focus of construction monitoring in this area will be related to runoff and sediment transport to adjacent areas, as defined in the NPDES permit.

6.5.2.1.2 Harris Reservoir

Harris Reservoir was created to provide cooling tower makeup water and Auxiliary Reservoir makeup water for the HNP, which first operated in 1987. From its headwaters east of the HAR site, near the Town of Fuquay-Varina,

Buckhorn Creek flows southwesterly for most of its length, then south toward its confluence with the Cape Fear River (Reference 6.5-024).

The HNP site implemented a monitoring program as part of its ER. The data collected under this program since 1972 (i.e., the initial baseline assessment and subsequent monitoring efforts) were used to assess the overall water quality of Harris Reservoir, identify any natural or power plant-induced effects on reservoir water quality, document the introduction and expansion of non-native plant and animal populations in the reservoir, and monitor the status of the recreational fishery. In addition to monitoring programs undertaken by the HNP, the North Carolina DWQ performed monitoring of Harris Reservoir under the Ambient Reservoirs Monitoring Program (ER Section 6.1).

A pre-application field investigation was conducted by biologists in August 2006 to account for potential inundation effects that could adversely affect streams and aquatic organisms as a result of construction activities at the HAR site.

The existing thermal database contains information that is deemed sufficient for use in describing thermal conditions in Harris Reservoir, as detailed in ER Subsection 2.3.3.2.1. The HNP conducted additional pre-application monitoring to verify and update the background conditions at the time of the HAR COLA (pre-application monitoring sites are described in Subsection 6.1.1.2). Additional sampling locations and more frequent measurements during summer months will be incorporated into the monitoring program, as the engineering design progresses. It is expected that these data will provide the necessary information to supplement the existing database and support descriptions of background conditions in Harris Reservoir.

In the early and mid-1980s, before operation of the HNP site, shoreline electrofishing and rotenone samples indicated the fish population of Harris Reservoir was typical of a Piedmont North Carolina reservoir and dominated by gizzard shad, largemouth bass, and other sunfish species (Reference 6.5-003).

PEC biologists began monitoring fish species by electrofishing in 1995. The North Carolina Index of Biotic Integrity (NCIBI) was used to evaluate the ecological health of fish communities. These scores are based on 12 metrics of fish community structures in the following five categories: species richness and composition, indicator species, trophic function, abundance and condition, and reproductive function. As shown in Table 2.4-5, there are 21 fish species and 1 hybrid from 7 stations (Reference 6.5-002).

Harris Reservoir has become more productive as a result of nutrient inputs from the watershed and from the HNP that have increased primary and secondary productivity. Based on PEC and NCDENR monitoring, it appears that nutrient inputs have stabilized since the mid-1990s, and Harris Reservoir supports a healthy, balanced biological community with thriving forage fish and game fish populations. The fish community is dominated by species native to the

southeastern United States, such as largemouth bass, bluegill, redear sunfish, white catfish, and gizzard shad (Reference 6.5-003).

The current monitoring program will be enhanced during construction and operation, as needed, to evaluate changes in the aquatic community, particularly with reservoir expansion and associated ecological changes. Furthermore, the program will be designed to detect any effects of plant operations on species abundance and diversity. PEC will consult with the NCWRC and NCDENR on the appropriate scope of this monitoring program.

6.5.2.1.2.1 Water Quality

PEC has monitored water quality and biological communities in the Harris Reservoir quarterly since the creation of the reservoir in the early 1980s to evaluate the water body's health, track changes in water quality, document the appearance of non-native plants and animals, and assess the state of recreational fishery.

Supporting data summaries and appropriate statistical analyses are used to describe and interpret the environmental quality of the reservoir.

Available hydrological and hydrogeological information was evaluated to determine if the data were sufficient to support the existing environmental descriptions presented in ER Subsection 2.3.1. The data evaluation was based on the location and number of monitoring stations that consider such factors as bathymetric characteristics of Harris Reservoir, soil and groundwater system characteristics, type of cooling system to be employed and probable operating modes, transient hydrological parameters near the site, sampling frequency and times that document temporal variations, and duration of the various monitoring programs.

Harris Reservoir has low turbidity, and efforts would be made to minimize temporary or permanent increases in turbidity from construction of operation of the HAR facility (Reference 6.5-025). It is especially important that sedimentation be controlled in the areas where dissolved oxygen levels are lower than the state standard, such as at Little White Oak Creek, White Oak Creek, and Big Branch (Reference 6.5-002). Monitoring will be conducted to ensure that further degradation of these areas does not occur.

6.5.2.1.2.2 Important Habitat or Species of Interest

Potential wetland impacts were assessed using a desktop evaluation and limited wetland field reconnaissance in 2006 (Reference 6.5-002). A more detailed delineation and mapping was initiated in 2008 and completed in December 2009 (Reference 6.5-030). USACE approved the Jurisdictional Determination in October 2010. This effort included a survey of areas that would be impacted by raising the current operating surface water elevation of 67.1 m (220 ft) to 73.2 m (240 ft) NGVD29. A total of 244 ha (603 ac) of wetlands would be flooded by

raising the elevation of Harris Reservoir. This would include 76 ha (188 ac) of forested wetlands, 0.9 ha (2.2 ac) of herbaceous wetlands, 138 ha (341 ac) of emergent wetlands, 2 ha (5 ac) of open water wetlands, and 26 ha (64 ac) of vegetated fringe wetlands. The wetlands are discussed in ER Subsection 2.4.2.2.

A total stream length of 45,425 m (149,033 ft) occurs between the 67.1- and 73.2-m (220- and 240-ft.) contours and will be inundated by the water level increase, which includes intermittent and perennial streams discussed in Subsection 2.4.2.2 (Reference 6.5-030).

Biologists conducted water quality analyses in August 2006 for streams that feed Harris Reservoir, using ecological health indicators of benthic macroinvertebrates and fish. Sites were selected from preliminary analysis of the projected reservoir footprint after expansion to an elevation of 73.2 m (240 ft.) from the previous elevation of 67.1 m (220 ft.). Streams and substantial drainages within the expansion area that could be affected by reservoir waters were selected for field reconnaissance as potential points of survey to ensure that controls are in place and working effectively (Reference 6.5-002).

Seven study stations were selected to evaluate the local watershed, land use channel substrates, stream width, bank height, bank stability, vegetation, and general water quality conditions. Macroinvertebrates were sampled at these seven habitat stations for analysis and data evaluation of overall ecological health. Results indicated that habitat conditions at most stations are not conducive to supporting robust macroinvertebrate communities, and that these areas have experienced stress (Reference 6.5-002).

In areas managed for timber harvest, streamside management zones have been established along all riparian zones (intermittent streams, open water shoreline, and wetlands) to act as buffers to protect surface water habitats from erosion and chemical applications (Reference 6.5-026).

Harris Reservoir provides limited marsh habitat in shallow backwaters. Migratory waterfowl use the marshes and adjacent shallows during certain seasons. Wading birds, such as egrets and great blue and green-backed herons, can also be seen during the summer. A great blue heron rookery, known to be active during recent breeding seasons, is located within the 67.1- and 73.2-m (220- to 240-ft.) contours (Reference 6.5-003). That area would be cleared before inundation, but clearing follows the great blue heron breeding season (March through May) to minimize adverse effects. Before clearing the area with the blue heron rookery, a permit would be obtained from the Region 4 USFWS Migratory Bird Permit Office. Surveys would be conducted to note the presence or absence of blue herons before any activities occur in this area. Additional specific monitoring requirements would be determined by the appropriate permits (e.g., CWA 404/401).

Surveys would be conducted to note the presence or absence of any species of interest in this area before any site preparation or construction activities occur.

Additional specific monitoring requirements would be determined by the appropriate permits.

6.5.2.1.2.3 Species of Commercial or Recreational Value

Harris Reservoir offers anglers a variety of fishing opportunities. As noted, monitoring programs to identify effects to fishery resources resulting from operation of the HAR facility will be recommended once the final design is confirmed. PEC would coordinate with the NCDENR and NCWRC to design a monitoring program that complements the ongoing monitoring efforts and studies conducted by these agencies. In addition, the proposed program would provide the opportunity to monitor species of commercial and recreational value within the vicinity.

6.5.2.1.3 Cape Fear River Intake Structure and Pumphouse/Cape Fear River

The Middle Cape Fear River Basin Association (MCFRBA) monitors the Cape Fear River periodically. The concurrent monitoring program serves as a consistent indicator of whether conditions within the basin are adversely altered (Reference 6.5-027).

An unnamed tributary canal flows into the Cape Fear River immediately upstream of the Buckhorn Dam at the location of the proposed intake structure and pumphouse. The discharge canal carries runoff from the Cape Fear Plant and surrounding areas to the Cape Fear River (Reference 6.5-014). The discharge canal has vegetation typical of the riparian corridor along the Cape Fear River and has largely remained undisturbed for several years (Reference 6.5-002).

6.5.2.1.3.1 Important Habitat or Species of Interest

The federally endangered Cape Fear River shiner is endemic to several tributaries of the Cape Fear River (Reference 6.5-028). The Carolina Redhorse may be present in the Cape Fear River (undetermined at this point) (ER Subsection 4.3.2.2.3). If either species is detected at any time, PEC will consult with the appropriate resource agencies on any monitoring or mitigation to protect these species. The USFWS will be consulted during the monitoring plan design and development to ensure these species are not adversely affected. In addition, the USFWS lists six fish and six mussel species that are of special concern in the area (Subsection 2.4.2.1.5). The habitat for three host darter species and the dwarf wedge mussel is present in the streams that flow into the Cape Fear River. However, extant populations of the wedge mussel are not known from the Cape Fear basin, and it is unlikely that the mussels are present in this area (Reference 6.5-028).

The NCDENR currently lists 104 species of fish occurring in the Cape Fear drainage basin (Reference 6.5-017). Water withdrawal activities on the Cape

Fear mainstem could potentially affect the fisheries community among the smaller minnows and juvenile fish. PEC will consult with the appropriate resource agencies on the necessary water withdrawal and flow studies prior to the site preparation phase.

6.5.2.1.4 Makeup Water Pipeline Corridor

The makeup water pipeline corridor crosses seven stream channels and contains two wetlands (ER Subsection 2.4.2.4.1). One perennial stream crosses the ROW; other channels are small ephemeral and intermittent drainageways. The two wetlands identified by biologists during the pre-application field survey include an emergent wetland adjacent to the Cape Fear River at the terminus of the ROW, and a small open water wetland around a pond within the existing utility ROW (Reference 6.5-002).

6.5.2.1.4.1 Important Habitat or Species of Interest

The Sandhills chub, a state special concern species, resides in a stream crossing the Harris-Fayetteville corridor (Reference 6.5-003). Its habitat includes slow-flowing headwaters, creeks, and small rivers with sand and gravel bottoms and sparse vegetation. Surveys will be required before construction, if the habitat is to be disturbed.

6.5.2.2 Site Preparation and Construction Monitoring

Specific monitoring requirements determined by the appropriate permits will be designed to ensure that sedimentation is not occurring to an extent that adversely affects the aquatic ecosystem. In addition, the reservoir would be monitored during operation to ensure that water withdrawal remains within operating parameters. This monitoring plan is addressed in Section 6.3.

The combination of monitoring for fishery resources and aquatic species, in addition to the water quality monitoring program that will be implemented, is expected to be adequate for identifying any potential adverse effects to Harris Reservoir resulting from construction and operation of the HAR facility.

6.5.2.2.1 Developed HAR Site

No adverse aquatic ecological effects are expected on the developed HAR site. The primary focus of construction monitoring in this area will be related to runoff and sediment transport to adjacent areas, as defined in the NPDES permit.

6.5.2.2.2 Harris Reservoir

During timber clearing and other construction work around Harris Reservoir, water quality will be carefully monitored at locations expected to be affected the most such as the HAR site, spillway, and makeup water pipeline outfall into Harris Reservoir. Periodic monitoring will also occur in stream channels and parts

of Harris Reservoir to ensure that effects are minimized and controls maintained to minimize sedimentation. Permits will be required for construction and operation activities, and specific monitoring requirements will be listed in the permits (Reference 6.5-002). Specific monitoring requirements will be determined by the appropriate permits. Any additional sampling techniques, locations, and/or modifications to the existing monitoring program used to evaluate construction and operation effects of the HAR will be discussed with the NCWRC and DWQ prior to implementation.

6.5.2.2.2.1 Important Habitat or Species of Interest

Clearing and construction for HAR 2 and HAR 3 would be conducted in accordance with federal and state regulations, permit requirements, PEC procedures, and BMPs to minimize adverse effects to wetlands or aquatic wildlife. Streamside management zones are designated along all riparian zones to trap and filter out sediment and applied chemicals before reaching the body of water. In addition, BMPs, as designated by the North Carolina Division of Forestry Resources, are followed. These practices include integrating buffers when possible, installing water retention bars to prevent soil erosion, and controlling stream crossings by logging equipment (Reference 6.5-026).

Specific monitoring requirements will be designed to meet conditions of permits, minimize adverse environmental effects, and ensure organisms are protected against construction or operational activities. Monitoring will include designing adequate sampling locations along stream and riparian zones to ensure controls are in place and working effectively. Surveys of target species will be required to ensure protection of natural populations or sensitive habitat.

Wetlands located outside the 67.1- and 73.2-m (220- and 240-ft.) contours would be delineated in accordance with USACE guidelines, and mitigation measures would be implemented. Specific monitoring requirements for construction and operations affecting wetlands and floodplains would be prescribed in the various permits.

Appropriate USACE Section 404, Independent Energy Producers Association (IEPA) 401 Water Quality Certification, and NPDES permits will be obtained as part of site preparation activities. Clearing and construction will be conducted to minimize sedimentation. Work will be conducted pursuant to Title 15 A-Chapter 4 of the North Carolina Administrative Code, the Erosion and Sedimentation Control Ordinance of Wake County, and the Chatham County Soil Erosion and Sedimentation Control Ordinance. An erosion and sedimentation control plan will be submitted for approval, and a Land-Disturbance Permit obtained from Chatham and Wake counties (ER Subsection 4.2.1).

A great blue heron rookery, known to be active during recent breeding seasons, is located within the 67.1- and 73.2-m (220- to 240-ft.) contours (Reference 6.5-003). That area would be cleared before inundation, but clearing would follow the great blue heron breeding season (March through May) to

minimize adverse effects. Before clearing the area with the blue heron rookery, a permit would be obtained from the Region 4 USFWS Migratory Bird Permit Office. Surveys would be conducted to note the presence or absence of blue herons before any activities occur in this area. Additional specific monitoring requirements would be determined by the appropriate permits (e.g., CWA 401 or 404).

6.5.2.2.2.2 Fisheries Resources

The program proposed in the HNP ER included fish sampling at 10 sampling locations identified in the preliminary baseline assessment. The report proposed that quarterly sampling continue at these locations so that fishery resources are sampled during each season of the year. New locations within Harris Reservoir, associated with the proposed intake structure and discharge from the HNP facility, will be monitored, as appropriate, to evaluate effects on fishery resources during operation. Sampling techniques will be in accordance with accepted methods and approved by the NCDENR.

6.5.2.2.3 Cape Fear River Intake Structure and Pumphouse/Cape Fear River

Construction of the cooling water intake structure will disturb sediments (dredging, pile driving) and soils (shoreline construction) at the construction site. Efforts will be made to limit the distribution downstream of sediments and debris. Dredging and construction work will require permits from the USACE. Construction and operational monitoring, as well as monitoring of wetland areas created for mitigation purposes, will be designed to meet federal CWA 404 and state CWA 401 permit requirements.

The MCFRBA monitors the Cape Fear River periodically. Their concurrent monitoring program serves as a consistent indicator of whether conditions within the basin are adversely altered (Reference 6.5-027). The combination of monitoring for fishery resources and aquatic species in addition to the implementation of the water quality monitoring program is adequate for identifying any potential adverse effects to Harris Reservoir resulting from construction of the HAR facility.

6.5.2.2.3.1 Important Habitat or Species of Interest

The federally endangered Cape Fear River shiner is endemic to several tributaries of the Cape Fear River, and the Carolina redhorse may be present in the Cape Fear River (undetermined at this point) (ER Section 4.3) (Reference 6.5-015). Monitoring in compliance with the CWA 404 permit would be required for any dredging activities occurring on the Cape Fear River to protect affected mussel species.

The intake structure will be designed to comply with USEPA Phase I 316(b) guidelines to minimize impingement and entrainment effects to aquatic

organisms in the Cape Fear River, and also to comply with DWQ NPDES permit requirements.

Cooling water intake structures can cause adverse environmental effects by pulling large numbers of fish and shellfish or their eggs into a power plant's cooling system, where organisms can be killed or injured by heat, physical stress, or chemicals used to clean the cooling system. Larger organisms will be killed or injured if they are trapped against screens at the front of an intake structure (Reference 6.5-029). The cooling water intake on the Cape Fear River will move water to Harris Reservoir to maintain the reservoir level. Specific monitoring requirements will be designed to meet conditions of the CWA 316b permit to minimize adverse environmental effects and ensure organisms are protected against the cooling water intake structures.

6.5.2.2.4 Makeup Water Pipeline Corridor

Installation of the makeup water pipeline will affect aquatic resources only at wetland and stream crossings. Federal, state, and local permits would be obtained before installation of stream crossings. Wetlands would be delineated and regulatory status determined according to CWA 404/401 permit requirements; regulated wetlands would be mitigated in accordance with these permit requirements. Stream and channel crossings would be monitored following construction to ensure that adequate restoration has been implemented.

6.5.2.3 Pre-Operational Monitoring

Pre-operational monitoring will continue the studies conducted during the pre-application and site preparation and construction plan phases, enhancing the program with specific permit requirements as the additional two reactors become operational. Any monitoring studies proposed during the pre-operational phase will follow permit requirements under the general NPDES permit, and after discussions with resource agencies, on the potential effects to the resource from operation of the HAR facility.

6.5.2.3.1 HAR Site

Pre-operational monitoring would consist of specific permit requirements.

6.5.2.3.2 Harris Reservoir

Pre-operational monitoring will employ the same activities as those in the pre-application and construction monitoring phases, as needed, to provide the necessary data for assessing alterations of surface water flow fields in Harris Reservoir (namely, the cooling loop), sediment transport, floodplains, or wetlands. The program will use the same sampling locations used by the HNP and NCDENR to the greatest extent practical. Permits will be required for construction and operation activities, and specific pre-operational monitoring

requirements will be listed in the specific permits (Reference 6.5-002). Additional sampling locations may be selected based on permit requirements or agency discussions.

6.5.2.3.2.1 Important Habitat or Species of Interest

Specific monitoring requirements for pre-operation affecting wetlands and floodplains would be prescribed in the various permits. Any required mitigation of wetland and stream effects are subject to monitoring requirements during operation.

Specific monitoring requirements will be designed to meet conditions of permits, minimize adverse environmental effects, and ensure organisms are protected against construction or operational activities. Monitoring, as specified by these permits, would include designing adequate sampling locations along stream and riparian zones to ensure controls are in place and working effectively. Surveys of target species will be required to ensure protection of natural populations or sensitive habitat.

6.5.2.3.3 Makeup Water Pipeline Corridor

Pre-operational monitoring will build on the pre-application and site preparation and construction monitoring parameters. Effects would be minimized by adhering to federal, state, and local permit requirements and following BMPs. Wetlands, previously determined according to CWA 404/401 permit requirements, would be mitigated in accordance with these permits. Stream and channel crossings would be monitored periodically following construction to ensure that adequate restoration has been implemented.

6.5.2.4 Operational Monitoring

Operational monitoring will continue the studies conducted during the previous phases, enhancing the program with specific permit requirements as the additional two reactors become operational. In addition, the program will overlap with other specific monitoring plans (e.g., hydrology). Any monitoring studies proposed during the operational phase will follow permit requirements under the general NPDES permit and after discussions with resource agencies on the potential effects to the resource from operation of the HAR facility. Monitoring during the operational phase will follow permit requirements under the general NPDES permit.

6.5.2.4.1 HAR Site

Operational monitoring would consist of specific permit requirements.

6.5.2.4.2 Harris Reservoir

Operations that require monitoring include intake and discharge of cooling water and intake of makeup water. Permits will be required for construction and operation activities, and specific monitoring requirements will be listed in the permits (Reference 6.5-002).

The operational monitoring program for Harris Reservoir will be designed to identify effects from the operation of HAR 2 and HAR 3, and monitoring will be modified based on consultations with the NCDENR and the HNP. Data from this program will be evaluated to determine changes in the cooling system flows, water levels in Harris Reservoir, and discharges from Harris Reservoir to Buckhorn Creek (Reference 6.5-002).

6.5.2.4.2.1 Important Habitat or Species of Interest

Specific monitoring requirements will be designed to meet the conditions of permits, to minimize adverse environmental effects, and ensure organisms are protected against operational activities. Monitoring, as specified by these permits, would include designing adequate sampling locations along stream and riparian zones to ensure controls are in place and working effectively. Surveys of target species will be completed, as required by specific permit conditions, to ensure protection of natural populations or sensitive habitat.

6.5.2.4.3 Makeup Water Pipeline Corridor

Installation of the makeup water pipeline will affect aquatic resources only at wetland and stream crossings. Effects would be minimized by adhering to permit requirements and following BMPs. Specific monitoring requirements will be determined by the appropriate permits. A summary of monitoring requirements is provided in Table 6.5-1.

The Harris Reservoir level will be monitored, as required, to meet the operating level necessary for power plants. The design of select sampling locations will be developed with consideration of effects from operational drawdown, and specific monitoring requirements will be determined by the appropriate permits.

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Table 6.5-1 (Sheet 1 of 4)
Terrestrial Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
HAR Site	Field investigations conducted in August 2006 to observe habitat and species abundance. A habitat survey conducted by USFWS (no areas within the HAR site are designated by the USFWS as critical habitat for federally threatened or endangered species).	Runoff and sediment transport to adjacent areas monitored, as defined in the NPDES permit. Relocation of native species, if found during surveys, will occur from the HAR site.	Runoff and sediment transport to adjacent areas monitored, as defined in the NPDES permit.	Runoff and sediment transport to adjacent areas monitored, as defined in the NPDES permit.
Harris Reservoir Perimeter	Self assessments conducted by HNP and CP&L to determine species composition and relative abundance within HNP vicinity. Surveys of forest communities and environmentally sensitive areas performed around the perimeter of Harris Reservoir. August 2006 field investigations performed to characterize habitats that occur between elevations of 67.1 and 73.2 m (220 and 240 ft.) surrounding Harris Reservoir. North Carolina State University monitoring of Harris Research Tract performed. Field investigations conducted in August 2006 to identify wetlands and observe habitat and species abundance. An archaeological investigation of HAR site conducted in fall 1978, along with an archaeological reconnaissance and geomorph investigation of inundation area surrounding Harris Reservoir.	Existing programs established by HNP/CP&L and other agency monitoring programs built on, as required by specific permit conditions, as follows: 1) Conduct surveys before construction, and periodically thereafter, for target species (bald eagle, red cockaded woodpecker) 2) Conduct survey before construction around the perimeter of Harris Reservoir to identify target areas for relocation of native plants. Then, sample plant communities on a periodic basis to determine and denote changes in species composition and abundance in the vicinity to ensure controls are in place and working effectively. Volunteer organizations contacted regarding plant relocation, if necessary. 3) Perform wetland delineation in accordance with USACE guidelines and mitigation measures implemented in accordance with CWA 404/401 permit requirements. 4) Determine appropriate timing of construction activities to accommodate the life cycles of less mobile species.	Existing programs established by HNP/CP&L and other agencies built on, and site preparation and construction monitoring performed, as required by specific permit conditions: 1) Sample plant communities on a periodic basis to determine and denote changes in species composition and abundance in the vicinity to ensure controls are in place and working effectively. 2) Conduct periodic surveys to determine species composition, distribution, and relative abundance of bird species present during migratory and nesting periods. 3) Conduct periodic surveys of waterfowl at Harris Reservoir and other waterbodies in the vicinity, as appropriate, to confirm that changes in composition, abundance, or distribution are not occurring. 4) Conduct periodic surveys at specific locations within the vicinity to determine composition and abundance of small animal populations.	Existing programs established by HNP built on, site preparation and construction and pre-operational monitoring performed, as required by specific permit conditions: 1) Sample plant communities on a periodic basis to determine and denote changes in species composition and abundance in the vicinity to ensure controls are in place and working effectively. 2) Conduct periodic surveys to determine species composition, distribution, and relative abundance of bird species present during migratory and nesting periods. 3) Conduct periodic surveys of waterfowl at Harris Reservoir and other waterbodies within the vicinity, as appropriate, to confirm that changes in composition, abundance, or distribution are not occurring. 4) Conduct periodic surveys at specific locations within the vicinity to determine composition and abundance of small animal populations.

Table 6.5-1 (Sheet 2 of 4)
Terrestrial Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
Harris Reservoir Perimeter (cont.)	A habitat survey conducted by USFWS (no areas within the HAR site are designated by the USFWS as critical habitat for federally threatened or endangered species).	5) Monitor erosion to verify controls for minimizing sediment deposition are in place and adjacent ecosystems are not being affected during timber removal. 6) Monitor area surrounding HAR site for species of interest that will occur in or near areas of effect. USFWS contacted to confirm the presence or absence of any federally listed (or proposed for listing) threatened or endangered animals. 7) Monitor effects to habitat buffers and wetland areas for small mammals, reptiles, and amphibians to verify controls are in place and adjacent ecosystems are not being affected. 8) Conduct periodic surveys of waterfowl at Harris Reservoir and other waterbodies in the vicinity, as appropriate, to confirm that changes in composition, abundance, or distribution are not occurring as a result of site preparation or construction activities at the HAR facility. 9) Follow specific monitoring requirements for construction and operation activities affecting wetlands, floodplains, and other natural areas as specified in the permits or as designated by appropriate agencies. 10) Survey Harris Research Tract to ensure there is no effect to Michaux's sumac. 11) Perform Phase I archaeological investigation, followup investigations pursuant to Section 106 of the National Historic Preservation Act, and cultural resource assessment.	5) Conduct periodic field surveys at specific locations within the vicinity to observe species of interest or sensitive habitat. 6) Follow specific monitoring requirements for pre-operational activities affecting wetlands, floodplains, and other natural areas as specified in the permits or as designated by appropriate agencies. 7) Survey Harris Research Tract to ensure there is no effect to Michaux's sumac.	5) Conduct periodic field surveys at specific locations within the vicinity to observe species of interest or sensitive habitat. 6) Specific monitoring requirements for operational activities affecting wetlands, floodplains, and other natural areas will require monitoring, as specified in the permits or as designated by appropriate agencies. 7) Survey Harris Research Tract to ensure there is no effect to Michaux's sumac.

Table 6.5-1 (Sheet 3 of 4)
Terrestrial Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
Cape Fear River Intake Structure and Pumphouse	CP&L/HNP survey assessments, field investigations, and data evaluation performed.	Monitoring will be required in accordance with the NPDES permit during construction to ensure appropriate controls are in place to prevent sedimentation of the Cape Fear River.	Monitoring performed in accordance with the NPDES permit to ensure appropriate controls are in place to prevent sedimentation of the Cape Fear River.	Monitoring performed in accordance with the NPDES permit to ensure appropriate controls are in place to prevent sedimentation of the Cape Fear River.
Makeup Water Pipeline Corridor	An August 2006 evaluation performed to assess resources along the proposed corridor for the makeup water pipeline. An archaeological survey of the proposed water makeup line corridor from Cape Fear River to Harris Reservoir performed. Surveys of NCWRC Game Lands performed.	Existing programs established by HNP/CP&L and other agency monitoring programs built on, as required by specific permit conditions: 1) Perform monitoring for potential receptors and target species — additional monitoring will be needed, because this corridor also crosses the NCWRC Game Lands. 2) Conduct seasonally appropriate surveys for several species of interest before any activities to prevent disturbing these species' habitats and ensure there are no negative effects. 3) Conduct survey before construction along the corridor to identify target areas for relocation of native plants. Sample plant communities on a periodic basis to determine and denote changes in species composition and abundance in the vicinity to ensure controls are in place and working effectively. Volunteer organizations will be contacted regarding plant relocation, if necessary. 4) Perform monitoring of pipeline installation during construction and immediately following construction to ensure disturbance is minimized and erosion control measures are in place, ensuring effects from runoff are minimized and restoration activities are adequate and effective.	Existing programs established by HNP/CP&L and other agencies built on, and site preparation and construction monitoring performed, as required by specific permit conditions: 1) Monitor for potential receptors and target species periodically. 2) Conduct seasonally appropriate surveys for species of interest that inhabit areas and habitat types. 3) Monitor pipeline to ensure erosion control measures are in place (i.e., effects from runoff are minimized and restoration activities are adequate and effective). 4) Monitor stream crossings periodically.	Existing programs established by the HNP built on, and site preparation and construction and pre-operational monitoring performed, as required by specific permit conditions: 1) Monitor for potential receptors and target species periodically. 2) Conduct seasonally appropriate surveys for species of interest that inhabit areas and habitat types. 3) Monitor pipeline to ensure erosion control measures are in place (i.e., effects from runoff are minimized and restoration activities are adequate and effective). 4) Monitor stream crossings periodically.

Table 6.5-1 (Sheet 4 of 4)
Terrestrial Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
Makeup Water Pipeline Corridor (cont.)		5) Monitor stream crossings periodically. 6) Ensure planning efforts associated with the pipeline corridor will take into consideration existing historic properties and consultation with the SHPO.		
Transmission Lines	Previous CP&L/HNP survey assessments and field investigations reviewed for important habitats and/or species of interest. Surveys of the NCWRC Game Lands performed.	Once the precise routes of the three new transmission lines are selected, additional monitoring stations and procedures will be selected to identify and ensure that rare, threatened, and endangered species and sensitive natural areas are not affected by construction or operation of the HAR facility. Monitoring will be conducted, as required by specific permit conditions. Before construction, surveys conducted along the route to identify target areas for relocation of native plants. Then, plant communities sampled on a periodic basis to determine and denote changes in species composition and abundance in the vicinity to ensure controls are in place and working effectively. Volunteer organizations will be contacted regarding plant relocation, if necessary. Periodic surveys of the NCWRC Game Lands conducted, as required by specific permit conditions. Monitoring performed, as required by the NPDES (Construction Stormwater Discharge for Stand Alone Construction Projects) and possible CWA 404/401 permit.	Seasonally appropriate periodic surveys conducted for species of interest that inhabit areas and habitat types bisected by current and proposed transmission lines, as required by specific permit conditions. Periodic surveys of the NCWRC Game Lands conducted, as required by specific permit conditions.	Seasonally appropriate periodic surveys conducted for species of interest that inhabit areas and habitat types bisected by current and proposed transmission lines, as required by specific permit conditions. Periodic surveys of the NCWRC Game Lands conducted, as required by specific permit conditions.

Table 6.5-2 (Sheet 1 of 3)
Aquatic Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
HAR Site	The HNP site implemented a monitoring program as part of its ER; data have been collected under this program since 1972.	The primary focus of construction monitoring in this area will be related to runoff and sediment transport to adjacent areas as defined in the NPDES permit.	Monitoring will consist of specific permit requirements.	Monitoring will consist of specific permit requirements.
Harris Reservoir Perimeter	Water quality data collected under HNP ER site program since 1972. A stream-based pre-application biological assessment was conducted by biologists in August 2006 to verify and update the background conditions. Further water quality analyses were completed, using the ecological health indicators of benthic macroinvertebrates and fish. North Carolina DWQ monitoring of Harris Reservoir conducted under the Ambient Lakes Monitoring Program.	Monitoring will be conducted as required by specific permit conditions. Examples are as follows: Existing programs established by HNP/CP&L and other agency monitoring programs built on, and overlap with the proposed hydrological monitoring program to establish background conditions for surface water and groundwater before construction and operation. Water quality will be carefully monitored in stream channels and portions of Harris Reservoir that have the potential to be affected. Monitoring, as specified by applicable CWA 404 and Section 202, IEPA 401 Water Quality Certification and NPDES permits, would include designing adequate sampling locations along stream and riparian zones to ensure controls are in place and working effectively. The program will be modified, as needed, to ensure that further degradation of species abundance and diversity in these areas does not occur.	Monitoring will be conducted, as required, by specific permit conditions. Examples are as follows: Existing programs established by HNP/CP&L and other agencies built on, site preparation and construction monitoring continued, and overlap with the hydrological monitoring program. Additional locations and more frequent measurements during summer months will be incorporated into the monitoring program as the engineering design progresses. Overall water quality of Harris Reservoir assessed, any construction effects on reservoir water quality identified, introduction and expansion of non-native plant and animal populations in the reservoir documented, and the status of the fishery monitored. The program will be modified, as needed, to ensure that further degradation of species abundance and diversity in these areas does not occur.	Monitoring will be conducted, as required, by specific permit conditions. Examples are as follows: Existing programs built on, site preparation and construction and pre-operational monitoring continued, and overlap with the hydrological monitoring program. Overall water quality of Harris Reservoir assessed, any natural or power plant-induced effects on reservoir water quality identified, the introduction and expansion of non-native plant and animal populations in the reservoir documented, and the status of the fishery monitored. The program will be modified, as needed, to ensure that further degradation of species abundance and diversity in these areas does not occur. Efforts coordinated with the NCDENR to monitor Harris Reservoir fisheries resources.

Table 6.5-2 (Sheet 2 of 3)
Aquatic Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
Cape Fear River Intake Structure and Pumphouse/Cape Fear River	Twenty years of data from HNP ongoing monitoring efforts. The Middle Cape Fear River Basin Association (MCFRBA) monitors the Cape Fear River periodically.	Monitoring will be conducted, as required, by specific permit conditions. Examples are as follows: Before construction, tributaries of river surveyed for presence of federally endangered species. Efforts coordinated with the USFWS. Effects on water withdrawal studied. Water quality will be carefully monitored at the locations expected to be affected most heavily by construction. Monitoring will be required in accordance with the NPDES permit and CWA 404/401 permits during construction to ensure appropriate controls are in place to prevent sedimentation. All federal, state, and local permit requirements for monitoring will be followed. Dredging and construction activities will require permits from the USACE. All construction monitoring, as well as monitoring of wetland areas created for mitigation purposes, will be designed in accordance with CWA 404/401 permit requirements. Surveys for target species or state special concern species conducted, as required by specific permit conditions.	Pre-operational monitoring will be required in accordance with the NPDES permit and CWA 404 permit to ensure appropriate controls are in place. All federal, state, and local permit requirements for monitoring followed. Pre-operational monitoring will be required in accordance with the NPDES permit and CWA 404/401 permits to ensure appropriate controls are in place. All federal, state, and local permit requirements for monitoring followed.	Monitoring will be required in accordance with the NPDES permit during operations to ensure appropriate controls are in place to prevent sedimentation of the Cape Fear River. Major components of the evaluation will include in situ water quality measurements (DO, temperature, pH, specific conductance, and turbidity), habitat assessment, and benthic macroinvertebrate community monitoring. All operational monitoring, as well as monitoring of wetland areas created for mitigation purposes, will be designed in accordance with CWA 404/401 permit requirements. Surveys for target species or state special concern species conducted, as required by specific permit conditions.

Table 6.5-2 (Sheet 3 of 3)
Aquatic Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
Makeup Water Pipeline Corridor	August 2006 evaluation to assess resources along the proposed corridor for the makeup water pipeline.	Monitoring will be conducted, as required, by specific permit conditions. Examples are as follows: Water quality will be carefully monitored at the locations expected to be affected most heavily by construction (small streams and wetland crossings). Periodic surveys for target species or state special concern species conducted.	Monitoring will be conducted, as required, by specific permit conditions. Examples are as follows: Monitoring of stream and channel crossings post-construction performed to ensure adequate restoration has been implemented. Periodic surveys for target species or state special concern species performed.	Wetlands monitoring performed in accordance with CWA 404 /401 permit requirements. Periodic surveys for target species or state special concern species performed, as required, by specific permit conditions.

6.6 CHEMICAL MONITORING

The chemical monitoring program for the COLA for HAR 2 and HAR 3 will include the following primary elements:

- **Pre-Application Chemical Monitoring**. This phase of the monitoring will establish background water quality conditions and support the chemical descriptions presented in Subsection 2.3.3 of the ER.

- **Pre-Operational Chemical Monitoring**. This phase of monitoring will identify chemical changes in the water resulting from developmental activities (site preparation and construction) and baseline conditions for identification and assessment of environmental effects before facility operation.

- **Operational Chemical Monitoring**. This phase of the monitoring will establish any chemical effects to surface water and groundwater that could result from facility operation.

The HNP currently monitors the water quality of Harris Reservoir to satisfy various environmental regulations, licenses, and permits associated with the construction and operation of the HNP. The timing of these assessments is discussed in the introduction to Section 6.1 of the ER.

In addition to the monitoring programs undertaken by the HNP, the NCDENR DWQ has monitored Harris Reservoir under the ALMP. Under this program, DWQ collected temperature and chemical data at 101 drinking water reservoirs in North Carolina, including Harris Reservoir. Information available from this monitoring program indicates that 13 monitoring events during the late summer months have occurred at Harris Reservoir since 1987. These events were designed to target periods of increased algal activity. Records indicate that Harris Reservoir water monitoring occurred in the following years (with the number of times indicated in parentheses): 1987 (1), 1989 (1), 1990 (1), 1991 (1), 1993 (1), 1996 (1), 2001 (4), and 2003 (3) (Reference 6.6-001). Figure 6.1-1 (in ER Section 6.1) presents the sampling locations for this program.

The objectives of the chemical monitoring program will be to identify environmental effects, including the potential degradation of water quality, caused by the development and construction of HAR 2 and HAR 3, and to identify alternatives or engineering measures that could be used to reduce any adverse effects that may be identified.

6.6.1 PRE-APPLICATION CHEMICAL MONITORING

The objective of the pre-application chemical monitoring program is to establish background levels of water quality in affected water bodies before the development and operation of HAR 2 and HAR 3. Water quality conditions presented in ER Subsection 2.3.3 are based on data collected under the HNP

existing NEMP and the HNP NPDES permit (Permit Number NC0039586) for Unit 1. Sampling was performed at select locations under these programs. Table 6.1-1 summarizes the chemical measurements conducted as part of the NEMP. Figure 6.1-1 shows the monitoring stations for both the NEMP and NPDES programs.

6.6.1.1 Freshwater Streams

The water quality for Buckhorn Creek is based on data collected by the HNP during site preparation and construction activities for the HNP. These studies were performed between 1978 and 1983 at Sample Locations BK2 and D2. Figure 6.1-1 shows these sampling locations. Monitoring Station BK2 is located approximately 3.2 km (2 mi.) downstream from the Main Dam spillway, and Station D2 is approximately 0.8 km (0.5 mi.) upstream from the convergence of the Cape Fear River and Buckhorn Creek. Monitoring Station D2 is located immediately upstream from the Buckhorn Dam at the proposed location of the Cape Fear makeup water intake structure.

The NEMP was modified in 1984 to concentrate monitoring efforts at major biological sampling stations. Water quality monitoring at Locations BK2 and D2 was discontinued after 1983 (Reference 6.6-002). In addition, between February 18, 1957, and September 27, 1983, the U.S. Geological Survey (USGS) collected limited water quality data from the Cape Fear River at the Lillington, North Carolina gauging station (Station No. 02102500) at a location approximately 22 km (13.5 mi.) downstream from Buckhorn Creek (Reference 6.6-003). Limited water quality data have been measured at two USGS gauging stations upstream from Buckhorn Creek: at the Haw River below B. Everett Jordan Dam (Station No. 02098198), approximately 18.2 km (11.3 mi.), and at the Deep River at Moncure, North Carolina (Station No. 02102000) approximately 18.5 km (11.5 mi.). Water quality data collection dates for each monitoring station are June 13, 1955 through August 15, 2004, and January 22, 1979 through September 9, 2004, respectively (Reference 6.6-004 and Reference 6.6-005).

Pre-application monitoring was conducted on January 2007 and monthly thereafter, to verify and update background conditions at the time of the HAR COLA. Pre-application water quality monitoring included water quality samples collected at previous Monitoring Stations BK2 and D2 (Figure 6.1-1). Water samples were collected concurrently with thermal measurements, as specified in Section 6.1 of the ER. DO, specific conductance, turbidity, pH, and temperature were measured at the surface of the stream using a YSI® Multiprobe or Multiparameter Instrument (or equivalent meter) (Table 6.1-1). Water samples were collected from the water surface. Chemical data obtained from these locations were used to monitor the conditions in Buckhorn Creek and Cape Fear River.

The existing database is sufficient to use for describing water quality conditions in the Buckhorn Creek and Cape Fear River.

6.6.1.2 Lakes and Impoundments

Pre-application monitoring was conducted to verify and update the background conditions for use in the HAR COLA. The pre-application chemical monitoring program was conducted for the NEMP from 1983 through today at the same frequency and locations as those specified for the thermal monitoring program (Section 6.1). Figure 6.1-1 shows the locations of the existing HNP monitoring sites, which are described in the following list:

- **E2**. Site E2 is located near the Main Dam, downstream from HNP NPDES Outfall 006 and the proposed outfall for HAR 2 and HAR 3. Data from this site are used to characterize chemical conditions associated with the discharge pipe and provide data to characterize the conditions of water being discharged to Buckhorn Creek.

- **P2**. Site P2 is located in the Harris Reservoir along the path of the cooling loop between the discharge of water into the reservoir and the Cooling Tower Makeup Water Intake for the HNP site and the HAR site. Data from this site are used to characterize conditions along the cooling loop.

- **H2 and S2**. Sites H2 and S2 are located in the Harris Reservoir within the Buckhorn Creek Branch and White Oak Creek Branch, respectively. Data from these sites have been included to help characterize background conditions entering Harris Reservoir and possible dispersion conditions from HNP NPDES Outfall 006 and the proposed outfall for HAR 2 and HAR 3.

Water samples were collected concurrently with the thermal measurements as specified in ER Section 6.1. Dissolved oxygen, specific conductance, turbidity, pH, and temperature were measured at the surface and at 1-m (3.3-ft.) depth intervals to the bottom of the water body using a YSI® Multiprobe or Multiparameter Instrument (or equivalent meter) (Table 6.1-1). The thickness of the water column was also recorded. Water samples were collected from the water body at 0.2 m (0.7 ft.) below the water surface and within 1 m (3.3 ft.) of the bottom. Chemical data from these locations were used to monitor the conditions in Harris Reservoir.

The list of analytical parameters included in the chemical monitoring program was similar to that monitored for the HNP. Table 6.1-1 summarizes those parameters for the HAR. Sample collection and analytical methods followed those outlined in PEC's QA/QC Program or the analytical laboratory vendor's QA/QC program and included standard analytical protocols, such as those listed in the "Standard Methods for the Examination of Water and Wastewater" (Reference 6.6-006) or "Methods for Chemical Analysis of Water and Wastes" (Reference 6.6-007). Samples were preserved in the field, as specified by the analytical method. Field and laboratory QA/QC samples were also collected at a

frequency of 10 percent. The samples were tracked using chain-of-custody protocols.

Additional locations may be incorporated into the chemical monitoring program as the engineering design progresses. Based on the sample locations, parameters, and procedures, the surface water data support the description of background conditions in Harris Reservoir. In addition, the chemical monitoring is coordinated with the data collection activities conducted for the HNP to avoid duplicate efforts.

The existing chemical database is sufficient to use for describing the chemical conditions in Harris Reservoir.

6.6.1.3 Groundwater

The pre-application chemical monitoring program for groundwater quality was implemented to support the assessment of site acceptability. In addition, the results obtained were used to identify the groundwater quality effects that could result from construction and operation of the HAR facility.

Historically, groundwater samples were collected and analyzed from three monitoring wells during site preparation activities for the HNP (Reference 6.6-008). Therefore, a limited pre-application chemical monitoring program was implemented to define background groundwater quality conditions. Selected monitoring wells screened within the surficial and bedrock aquifers were sampled during September 2006 and January 2007 in the immediate vicinity of the proposed locations of HAR 2 and HAR 3 (Table 6.6-1). Figure 6.6-1 presents these locations. The specific number and locations of the piezometers/wells and the analytical parameters were determined based on the groundwater flow patterns in and around the site, as determined by the measured water levels. ER Subsection 2.3.1.2.3 describes the groundwater flow and potentiometric levels.

Groundwater sampling methods followed standard purging and sampling protocols, such as those listed in the “Environmental Investigations Standard Operating Procedures and Quality Assurance Manual” (Reference 6.6-009). Dissolved oxygen, specific conductance, turbidity, pH, and temperature were measured during sampling activities using a YSI® Multiprobe or Multiparameter Instrument (or equivalent meter) equipped with a flow-through cell (Table 6.1-1).

Table 6.1-1 summarizes the analytical parameters included in the chemical monitoring program. Analytical methods followed those outlined in PEC’s QA/QC Program or the analytical laboratory vendor’s QA/QC program and included standard and analytical protocols, such as those listed in the “Standard Methods for the Examination of Water and Wastewater” (Reference 6.6-006) or “Methods for Chemical Analysis of Water and Wastes” (Reference 6.6-007). Samples were preserved in the field, as specified by the analytical method. Field and laboratory QA/QC samples were also collected at a frequency of 10 percent. The samples were tracked using chain-of-custody protocols.

The existing chemical database is sufficient to support the description of the groundwater system characteristics near HAR 2 and HAR 3, as detailed in ER Subsection 2.3.3.3.

6.6.2 CONSTRUCTION AND PRE-OPERATIONAL CHEMICAL MONITORING

The chemical monitoring of surface water and groundwater will be conducted to provide data necessary to assess water quality changes that result from construction and operation of HAR 2 and HAR 3. The objective of the construction and pre-operational monitoring is to characterize the water quality at the site, and to provide a baseline for the identification and measurement of water quality changes from operation of HAR 2 and HAR 3.

6.6.2.1 Freshwater Streams

The construction and pre-operational monitoring of Buckhorn Creek and Cape Fear River will be an extension of the pre-application monitoring until HAR 2 and HAR 3 are operational. During this period, the frequency of chemical monitoring will be modified to bi-monthly sampling events beginning approximately 1 year before site preparation activities to establish a baseline for water quality. The need for changes to the monitoring program (e.g., changes in monitoring stations, parameters, collection, or analytical procedures) will be assessed regularly over the duration of the construction and pre-operational chemical monitoring program.

6.6.2.2 Lakes and Impoundments

The construction and pre-operational monitoring will be an extension of the pre-application monitoring until HAR 2 and HAR 3 are operational. The water quality measurements conducted as part of the HNP NEMP will be used as the basis for the construction and pre-operational chemical monitoring program for HAR 2 and HAR 3. Table 6.1-1 summarizes the locations and parameters monitored.

New monitoring is proposed for the following locations:

- **V3**. Site V3 is located in the Harris Reservoir near the entrance to the cooling tower makeup water intake channel for the HNP. Data from this site will be used to characterize water quality conditions before usage within the cooling tower and indicate changes in the Thomas Creek Branch of the Harris Reservoir immediately downstream from the HNP and HAR site.

- **MP1**. Site MP1 is located in the Harris Reservoir within the Little White Oak Creek Branch. Data from this site will be used to characterize

background water quality conditions entering the reservoir and possible dispersion conditions from HNP NPDES Outfall 007.

- **MP2**. Site MP2 is located in the Auxiliary Reservoir near the Auxiliary Dam and the entrance to the Auxiliary Dam Spillway. Data from this site will be used to characterize water quality conditions before emergency usage for the HNP and indicate water quality changes within the Auxiliary Reservoir. Data from this new location will also be used to characterize the conditions of water being discharged to the Harris Reservoir.

- **MP3**. Site MP3 is located within a branch of the Harris Reservoir immediately downstream from the Cape Fear makeup water discharge structure. Data from this site will be used to help characterize background water quality conditions entering the reservoir from the Cape Fear River.

The frequency of chemical monitoring will be modified to periodic sampling events beginning approximately 1 year before construction activities to establish a refined baseline for water quality in Harris Lake. In addition, the need for modifications to the monitoring program (e.g., changes in monitoring stations, parameters, collection, or analytical procedures) will be assessed regularly and over the duration of the construction and pre-operational chemical monitoring program.

6.6.2.3 Groundwater

The chemical monitoring of groundwater will be conducted to provide data necessary to assess water quality changes that could result from the construction dewatering and operation of the HAR 2 and HAR 3. The objective of construction and pre-operational monitoring is to characterize the quality of groundwater at the site and provide a basis from which to identify changes in groundwater quality from the facility operation. Monitoring wells used during the pre-application monitoring could be destroyed during construction activities. Therefore, monitoring wells positioned along the perimeter of the construction area for HAR 2 and HAR 3 will be used to establish a baseline for groundwater and to monitor changes in water quality (Figure 6.6-2). The frequency of chemical monitoring will be modified to quarterly sampling events. The need for changes to the monitoring program (e.g., changes in monitoring stations, parameters, collection, or analytical procedures) will be assessed regularly over the duration of the construction and pre-operational chemical monitoring program.

6.6.3 OPERATIONAL CHEMICAL MONITORING

An operational chemical monitoring program will be implemented to identify changes in water quality that could result from the operation of HAR 2 and HAR 3. A consideration in the development of the operational chemical monitoring program is the ability to update the estimates of the effectiveness of various effluent treatment systems, and to provide real time warnings of any failures in the effluent treatment systems. The specific elements of the

operational chemical monitoring program for the assessment of surface water quality will be developed in consultation with the NCDENR relative to NPDES permit requirements (renewal) and with consideration of monitoring presently being conducted for the HNP.

The scope of the operational chemical monitoring program will be adjusted as necessary as the project transitions from pre-construction to construction, and finally to the operation of HAR 2 or HAR 3. Adjustments to the program will be made after discussions with NCDENR and take into consideration any NPDES permit requirements. If water quality trends for specific parameters demonstrate no significant changes throughout the monitoring project, analysis of those parameters will be reduced or deleted from the monitoring program, as necessary.

6.6.3.1 Freshwater Streams

Specifics related to the operational monitoring for Buckhorn Creek and Cape Fear River are anticipated to be similar to those for the construction and pre-operational monitoring program. The program may be modified based on data collected and consultations with NCDENR. The data will be evaluated by monitoring for water quality changes of the discharge of the makeup water from Cape Fear River to Harris Reservoir, from Harris Reservoir to Buckhorn Creek, and from Buckhorn Creek to Cape Fear River.

6.6.3.2 Lakes and Impoundments

The operational chemical monitoring program is anticipated to be an extension of the construction and pre-operational chemical monitoring program. Thus, chemical changes that result from facility operations can be evaluated. The data will be evaluated for chemical variability along the flow path as well as for temporal trends. The results of the operational monitoring and previous sampling events will be evaluated to determine if the scope and the frequency of chemical monitoring will be modified. The need for modifications to the monitoring program (e.g., changes in monitoring stations, parameters, collection, or analytical procedures) will be assessed regularly and over the duration of the operational chemical monitoring program.

6.6.3.3 Groundwater

The objective of the groundwater operational chemical monitoring program is to identify any changes in water quality that could result from the operation of HAR 2 and HAR 3. The operational chemical monitoring program is anticipated to be an extension of the construction and pre-operational chemical monitoring program. Thus, chemical changes that result from facility operations can be evaluated. The groundwater data from the pre-application, construction, and pre-operational sampling events will be evaluated, and the scope and/or the frequency of chemical monitoring will be modified, as needed. The need for modifications to the monitoring program (e.g., changes in monitoring stations,

parameters, collection, or analytical procedures) will be assessed regularly and over the duration of the operational chemical monitoring program.

6.6.4 REFERENCES

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Table 6.6-1 (Sheet 1 of 2)
Summary of Proposed Groundwater Chemical Monitoring Program for HAR 2 and HAR 3

Description	Pre-application	Pre-operational	Operational
Objective of Sampling Program	Establish background water quality in groundwater at the HAR site before site preparation and construction activities.	Establish baseline and document water quality changes during site preparation, construction, and pre-operational activities.	Document water quality changes during operation.
Wells Monitored	MWA-4S, -4D, -7S, -7D, -9S, and -9D	MWA-2S, -7S, and -12, W-13/GW-59, LP-6, LP-7, LP-9, LP-16, and WAD-1/GW-39	MWA-2S, -7S, and -12, W-13/GW-59, LP-6, LP-7, LP-9, LP-16, WAD-1/GW-39, and one additional well
	(see Figure 6.6-1)	(see Figure 6.6-2)	(see Figure 6.6-2)
Frequency	As needed for background.	Quarterly beginning approximately 1 year before site preparation activities (increase frequency if notable changes occur).	Quarterly
Field Parameters	Water temperature DO pH Turbidity Specific conductance	Water temperature DO pH Turbidity Specific conductance	Water temperature DO pH Turbidity Specific conductance
Collection of Field Parameters	With a flow-through cell after purging activities.	With a flow-through cell after purging activities.	With a flow-through cell after purging activities.
Water Quality Parameters	**General Water Chemistry** Alkalinity, total Ammonia-N Bicarbonate Carbon Dioxide Chloride Hardness Nitrate + Nitrite-N Total Kjeldahl Nitrogen (TKN) Orthophosphate Phosphorous, total Sulfate Sulfide Total dissolved solids Total organic carbon Total suspended solids	**General Water Chemistry** Alkalinity, total Ammonia-N Bicarbonate Carbon Dioxide Chloride Hardness Nitrate + Nitrite-N TKN Orthophosphate Phosphorous, total Sulfate Sulfide Total dissolved solids Total organic carbon Total suspended solids	**General Water Chemistry** Alkalinity, total Ammonia-N Bicarbonate Carbon Dioxide Chloride Hardness Nitrate + Nitrite-N TKN Orthophosphate Phosphorous, total Sulfate Sulfide Total dissolved solids Total organic carbon Total suspended solids

Table 6.6-1 (Sheet 2 of 2)
Summary of Proposed Groundwater Chemical Monitoring Program for HAR 2 and HAR 3

Description	Pre-application	Pre-operational	Operational
Water Quality Parameters	**Biological** Biological Oxygen Demand Chemical Oxygen Demand **Metals** Arsenic Boron Calcium Chromium, total Copper Iron Lead Magnesium Manganese Mercury Nickel Potassium Silica Sodium Zinc	**Biological** Biological Oxygen Demand Chemical Oxygen Demand **Metals** Arsenic Boron Calcium Chromium, total Copper Iron Lead Magnesium Manganese Mercury Nickel Potassium Silica Sodium Zinc	**Biological** Biological Oxygen Demand Chemical Oxygen Demand **Metals** Arsenic Boron Calcium Chromium, total Copper Iron Lead Magnesium Manganese Mercury Nickel Potassium Silica Sodium Zinc
Sample Collection for Water Quality Parameters	Purged groundwater within screened interval of well.	Purged groundwater within screened interval of well.	Purged groundwater within screened interval of well.
Data Analysis	Statistical trend analysis	Statistical trend analysis	Statistical trend analysis

6.7 SUMMARY OF MONITORING PROGRAMS

This section summarizes the individual environmental monitoring programs for thermal monitoring, radiological monitoring, hydrological monitoring, meteorological monitoring, ecological monitoring including terrestrial and aquatic communities, and chemical monitoring for HAR 2 and HAR 3. As appropriate, the summary covers (1) monitoring to be conducted during site preparation and project construction, (2) pre-operational monitoring, and/or (3) operational monitoring. A summary table describing the combined monitoring program is included as Table 6.7-1.

6.7.1 THERMAL MONITORING

6.7.1.1 Pre-Application Monitoring Program

Pre-application monitoring was conducted in streams, lakes, and impoundments to establish background water temperatures from associated water bodies before development and operation of HAR 2 and HAR 3. The monitoring stations used for the NEMP and NPDES programs are shown in Section 6.1, Figure 6.1-1 (Reference 6.7-001). Thermal, physical, and water quality measurements are summarized in Table 6.7-2.

6.7.1.2 Pre-Operational Monitoring Program

Pre-operational monitoring is designed to continue the pre-application monitoring activities during the developmental stages (site preparation and construction) of HAR 2 and HAR 3 until they are operational (Subsection 6.1.2). The data will be used to supplement the pre-application thermal monitoring data by providing additional water temperature data during construction activities. The thermal, physical, and water quality measurements conducted as part of the HNP NEMP will be used as the basis for the pre-operational monitoring for HAR 2 and HAR 3. The locations and parameters monitored are summarized in Table 6.7-2.

6.7.1.3 Operational Monitoring Program

Operational monitoring will be implemented to establish changes in water temperature resulting from HAR facility operation. The specific operational monitoring requirements will be developed in consultation with NCDENR, relative to NPDES permit requirements and the monitoring requirements for the HNP and HAR 2 and HAR 3. Although the specific procedures of the operational monitoring program have not been developed, it is anticipated that the monitoring stations will be similar to those used in the pre-operational monitoring program, as detailed in Subsection 6.1.3 and illustrated in Figure 6.1-1. The locations and parameters monitored are summarized in Table 6.7-2.

6.7.2 RADIOLOGICAL MONITORING

The REMP for HAR 2 and HAR 3 will be designed to monitor the radiological environment before the site preparation and construction phases from HNP facility operations, through the radiological environment surrounding the HAR during active facility operations. The primary objective is to monitor for potential radiological exposures to construction workers, the general public, and the surrounding environment during construction and active facility operations, as detailed in Subsection 6.2.1. To the greatest extent practical, PEC will use the HNP monitoring and sampling equipment, as well as previously established monitoring/sampling locations. A detailed description of the proposed REMP can be found in Subsection 6.2.1; sample sizes identified in Table 6.7-3 will provide enough material for standard sample analysis and quality control.

6.7.2.1 Pre-Operational Monitoring Program

The pre-operational monitoring program will be used to establish the baseline for the local radiation environment by measuring background levels and their variations along the anticipated critical pathways in the area surrounding the HAR, to train personnel, and to evaluate procedures, equipment, and techniques. However, as the proposed reactor will be sited near the HNP, the proposed pre-operational and operational phases of the REMP were developed from baseline data that were previously established for the HNP.

6.7.2.2 Operational Monitoring Program

The operational phase implements measurements to verify that the in-station controls for the release of radioactive material are functioning in accordance with their design.

The elements (sampling media and analysis type) for both the pre-operational and operational REMP phases will be essentially the same. To the greatest extent practicable, the proposed REMP will use the same sampling locations used by the HNP's existing REMP. New sampling locations may be selected based on the selected plant design parameters.

Figure 6.2-1 in Section 6.2 presents the basic pathways for gaseous and liquid radioactive effluent releases to the public. The "important pathways" selected are based primarily on how radionuclides move through the environment and eventually expose the public, taking into consideration human use of the environment. The scope of the program will include monitoring the media identified in Table 6.7-4.

Sampling locations were chosen by HNP based upon meteorological factors, pre-operational monitoring, and results of the land use surveys (Reference 6.7-002). Sample locations and control locations are presented in Figure 6.2-2 of Section 6.2; a description of each sample location may be found in Table 6.2-1 and Table 6.2-3.

Concentrations of radioactivity present in the environment will vary because of factors such as weather conditions, and variations in the sampling collection technique and sample analysis. Several types of measurements will be performed to provide information about the types of radiation and radionuclides present. Analyses performed on environmental samples collected will include gross alpha and beta analysis, gamma spectroscopy analysis, tritium analysis, strontium analysis, and gamma dose (TLD only) (Reference 6.7-002). A detailed description of sample analysis can be found in Subsection 6.2.3, and is summarized in Table 6.7-4.

TLDs will be used to measure the ambient gamma radiation levels at many locations surrounding the HAR. Monitoring stations will be placed in the facility proximity and approximately 8 km (5 mi.) from the proposed reactor in locations representing the 16 meteorological compass sectors. A detailed description of direct radiation monitoring can be found in Subsection 6.2.3.2.

Inhalation and ingestion of radionuclides in the air is a direct exposure pathway to humans and other organisms. A network of active air samplers will be used to monitor this pathway from the vent stacks (Reference 6.7-002). Air sampling stations will be strategically located in areas most likely to reveal any measurable effects resulting from the release of radioactive effluents from the HAR. The control will be located approximately 21 km (13.4 mi.) west/northwest of the HAR at Pittsboro. A detailed description of atmospheric monitoring can be found in Subsection 6.2.3.3 and is summarized in Table 6.7-4.

The HAR will use the existing Harris Reservoir as the source for raw water and cooling tower makeup water and will discharge cooling tower blowdown to the reservoir. Aquatic vegetation, fish, and sediments will be collected to detect the presence of any radioisotopes related to the operation of the HAR. These samples will be analyzed for naturally occurring and artificially produced radioactive materials. A detailed description of aquatic monitoring can be found in Subsection 6.2.3.4 and is summarized in Table 6.7-4.

Samples of shoreline sediments will be collected at Harris Reservoir. Radiological analyses will provide information on any potential shoreline exposure to humans by determining long-term trends and the accumulation of long-lived radionuclides from the environment. Samples will be collected semi-annually and analyzed as specified in Table 6.7-3.

In addition to direct radiation, radionuclides present in the atmosphere expose receptors when they are deposited on plants and soil and subsequently consumed. To monitor this pathway, samples of milk and broadleaf vegetation will be analyzed, as described in Subsection 6.2.3.5.1 and Subsection 6.2.3.5.2.

Water monitoring (e.g., the collection of drinking water, surface water, and groundwater [well water] samples) will be used to detect the presence of any radioisotopes relative to the operation of the HAR. The only identified users of

water from Harris Reservoir for domestic purposes are the HNP and the PEC facility. Samples will be analyzed following the requirements specified in Table 6.7-3.

Composite water samplers will be located at several locations to collect a small volume of surface water at regular intervals and discharge the sample into a large sample collection bottle. This water sample will be collected on a weekly basis and combined into a composite water sample on a monthly basis. Details are provided in Subsection 6.2.3.6.2 and Table 6.7-4.

Groundwater samples will be collected quarterly at five locations on-site and analyzed as specified in Table 6.7-3.

Radiological environmental sampling locations by HNP station number are shown on Table 6.7-5.

6.7.2.3 Quality Assurance Program

The standards for the QA Program are established in the NRC Regulatory Guide 4.15, “Quality Assurance for Radiological Monitoring Programs. A full discussion of the QA program monitoring can be found in Subsection 6.2.4.

6.7.3 HYDROLOGICAL MONITORING

6.7.3.1 Pre-Application Monitoring Program

This phase of the monitoring will support the baseline hydrologic descriptions presented in ER Section 2.3, and establish background conditions for surface water and groundwater before the construction and operation of HAR 2 and HAR 3. A summary of the proposed hydrological monitoring program is shown on Table 6.7-6.

The existing database is sufficient to describe the hydrological conditions in Harris Lake, as presented in Subsection 2.3.1.2. The proposed pre-application monitoring includes, at a minimum, the continued collection of the mean daily stage of the Main Reservoir and the Auxiliary Reservoir.

Additional monitoring may be incorporated into the program as the engineering design progresses. Although the exact locations and/or measurement methods (e.g., manual measurements or monitored remotely) may be modified, it is anticipated that additional data, once collected and evaluated, will provide the necessary information to supplement the existing database and support the description of background conditions in Harris Reservoir. In addition, monitoring is being coordinated with data collection activities conducted for the HNP to avoid duplicate efforts.

As discussed in Subsection 6.3.1.3, groundwater monitoring data are used to support the assessment of site acceptability and to identify effects to the

groundwater system that may result from construction and operation of HAR 2 and HAR 3. The available groundwater information was evaluated to determine if the existing database is sufficient to support the description of the groundwater system characteristics in the vicinity of the site (Subsection 2.3.1).

6.7.3.2 Site Preparation and Construction Monitoring Program

This phase of the monitoring plan will be used as a basis to monitor and control potential effects and limit effects to surface water and groundwater that could result from site preparation and construction activities. As discussed in ER Section 4.2, the construction-related effects to Buckhorn Creek are considered minimal, provided that the proper controls are implemented to minimize effects to Harris Reservoir. The proposed construction monitoring of Buckhorn Creek will include continuing the pre-application hydrological monitoring program.

Hydrological monitoring for Harris Reservoir has been designed to monitor anticipated effects from site preparation and construction, and to monitor potential effects arising from construction activities. As discussed in ER Chapter 4 (Environmental Impacts of Construction), the majority of the construction-related effects to Harris Reservoir are related to increased erosion and sediment transport (Section 4.2). A major element of the construction monitoring will be to monitor the amount of sediment deposited in Harris Reservoir as a result of construction activities (Subsection 6.3.2.2).

Water levels from wells and piezometers used for the pre-application monitoring program will be measured at weekly intervals during the active construction period to monitor lateral depression in the groundwater surface caused by dewatering. In addition, settlement points will be monitored to protect existing structures from settlement or ground movement during the excavation activities. These points will be monitored daily, at a minimum, and critical points may be monitored continuously. The data will be used to monitor for potential damage to existing structure foundations.

6.7.3.3 Pre-Operational Monitoring Program

This phase of the monitoring will provide a baseline for evaluating hydrological changes arising from operations of the HAR.

The plan for Buckhorn Creek will be a continuation of the monitoring conducted during pre-application and construction monitoring. Continued implementation of pre-application monitoring will provide the data necessary to assess alterations of surface water flow fields in Harris Reservoir (namely the cooling loop), sediment transport, floodplains, or wetlands. The program may be modified based upon the evaluation of the pre-application monitoring data and other information collected for the operation of HAR 2 and HAR 3.

Harris Reservoir will be used to meet the facility's water requirements and no groundwater will be used; therefore, there should not be a significant effect to the groundwater system from the operation of the HAR. However, pre-operational

monitoring will be conducted to re-establish baseline conditions for groundwater levels and flow following the completion of the construction activities. The monitoring will consist of the collection of water levels quarterly from wells and piezometers that remain after the HAR facility is constructed.

6.7.3.4 Operational Monitoring Program

The operational hydrological monitoring program will be designed to establish the effects from the operation of HAR 2 and HAR 3, and detect any unexpected effects that arise from facility operation. Based on the monitoring data for the HNP, the operational hydrological monitoring program is anticipated to extend over a 5-year period, or until conditions appear to have stabilized based on the trend analysis. Modifications to the monitoring program (e.g., changes in monitoring stations or collection procedures) will be assessed regularly over the duration of the monitoring program.

Specific procedures of the operational monitoring requirements of Buckhorn Creek are anticipated to be similar to the pre-application and pre-operational monitoring program requirements. The program may be modified based on data collected and consultations with the NCDENR and the HNP. The data will be evaluated to monitor for changes in the discharge from Harris Reservoir to Buckhorn Creek. The program will also include monitoring the automatic and continuous daily flow discharged to the Main Reservoir from the proposed Cape Fear River makeup water system. Monitoring may be modified based on consultations with the NCDENR and the HNP. The data from this monitoring program will be evaluated to determine changes in the cooling system flows, water levels in Harris Reservoir and discharges from Harris Reservoir to Buckhorn Creek.

A limited monitoring program will be implemented to establish effects to the groundwater system from the operation of HAR 2 and HAR 3, and detect any unexpected effects from facility operation. The objective will be to evaluate changes to the groundwater system related to potential changes in Harris Reservoir levels. Monitoring will consist of extending pre-operational monitoring for an additional 5-year period or until conditions appear to have stabilized based on the trend analysis of groundwater and surface water conditions. The need for modifications to the monitoring program (e.g., changes in monitoring stations or frequency of collection) will be assessed regularly over the duration of the monitoring program.

6.7.4 METEOROLOGICAL MONITORING

The on-site meteorological measurement program began in March 1973 with the installation of a 61-m (200-ft.) guyed, open-latticed tower (Reference 6.7–004). The location of the existing HNP meteorological tower (approximately 1.6 km [1 mi.] to the east-northeast) is ideally situated for use in support of HAR 2 and HAR 3. The monitoring results obtained from the tower will be used to characterize the on-site meteorological

conditions for the proposed units. The current elevations of the operational sensors for all monitored parameters at both the lower and upper monitoring levels are shown in Table 6.7-7. A detailed description of meteorological monitoring can be found in Subsection 6.4.1.

The meteorological monitoring program will remain consistent throughout the site preparation through the operational phases of the HAR. Therefore, the meteorological monitoring program section is not separated by project phase.

6.7.4.1 Wind Systems

Lower-level (12 m [39 ft.]) and upper-level (61 m [200 ft.]) wind speeds are recorded by sensors mounted on 3.7-m (12-ft.) retractable booms oriented perpendicular to the prevailing wind flow (southwest to the northeast) to minimize tower shadow effects. Wind direction, wind speed, and wind direction variance (sigma theta) are monitored at both the lower and upper levels of the tower (Reference 6.7-004).

6.7.4.2 Temperature Systems

The ambient temperature and delta temperature (delta-T) parameters are monitored at both the lower and upper levels of the tower. Dew point temperatures are monitored at the lower level only. Two channels of differential temperature are monitored simultaneously between the lower and upper levels. The temperature and dew point temperature probes are mounted in aspirated shields attached to a 2.4-m (8-ft.) retractable boom (Reference 6.7-004).

6.7.4.3 Precipitation and Solar Radiation Systems

Precipitation and solar radiation are monitored near ground level (Reference 6.7-004).

6.7.4.4 Maintenance and Calibration

The system datalogger and remote access equipment is checked and calibrated on a routine basis and in accordance with the NRC requirements. Accumulated system data are routinely analyzed for inconsistent or erratic data, including comparisons with appropriate meteorological data obtained from other local or regional meteorological observing stations.

Temperature sensors are thermistors purchased with NIST-traceable calibration documentation. Thermistors are inherently stable (100-month drift is less than 0.01°C) and routine sensor calibration or replacement is therefore not necessary. Deviation between the two ambient/differential temperature channels provides an early warning of a problem with one of these channels.

6.7.4.5 Data Reduction

Data from the HNP datalogger system are retrieved by way of a remote connection through a dedicated telephone link. If the primary telephone line is inoperable, a second dedicated telephone line is available for data retrieval. Using its host computer, an off-site meteorological consultant retrieves the meteorological data on a daily basis (except weekends or holidays). The retrieved data are reviewed for potential problems and then checked for consistency with data obtained from the nearby Raleigh-Durham National Weather Service observing station. Erroneous data are discarded before insertion into the historical site database. The edited and reviewed 15-minute averaged data are then stored on electronic media.

6.7.4.6 Accuracy of Measurements

The accuracy of the measurements of the monitored parameters, and the criteria upon which the accuracies are based, are summarized in Table 6.7-8 (Reference 6.7-004).

6.7.5 ECOLOGICAL MONITORING

6.7.5.1 Terrestrial Ecology

Surveys to monitor soil and terrestrial plant and animal communities will be conducted, as needed, after consultations with the pertinent resource agencies, on a site-specific basis due to an identified issue, or as directed by appropriate permit requirements.

6.7.5.1.1 Pre-Application Monitoring Program

This phase was designed to establish background conditions, provide appropriate information on principal ecological features of the site, and determine if the data are adequate to support the existing environmental descriptions presented in Subsection 2.3.3. This program incorporated baseline ecological surveys, existing environmental information, potential contaminant exposure pathway analyses, and other data collected during previous studies. A detailed description of pre-application monitoring can be found in Subsection 6.5.1.1 and is summarized in Table 6.7-9.

An archaeological investigation of the HAR site was conducted in fall 1978. In addition, an archaeological reconnaissance and geomorph investigation of the inundation area surrounding Harris Reservoir was conducted.

A habitat survey was conducted by the USFWS; it was determined that there are no areas within the HAR site designated by the USFWS as critical habitat for federally threatened or endangered species (Reference 6.7-005).

6.7.5.1.2 Site Preparation and Construction Monitoring Plan

Terrestrial monitoring activities are designed to identify and provide information to make decisions regarding the prevention or control measures for any identified effects from site preparation and facility construction. Construction monitoring will be required only if specific adverse effects are predicted and if conscientious construction practices, coupled with system inspection, is insufficient to prevent adverse effects.

Construction monitoring will be conducted in accordance with environmental permit conditions. The construction monitoring is coordinated with existing monitoring efforts being performed by the HNP, NCDENR, USEPA, and other applicable groups or agencies.

A detailed description of site preparation and construction monitoring can be found in Subsection 6.5.1.2 and is summarized in Table 6.7-9.

6.7.5.1.3 Pre-Operational Monitoring

PEC intends to build on the approved pre-application and site preparation and construction monitoring programs, providing enhancement and expansion, as needed, to accommodate the HAR 2 and HAR 3. If important environmental effects are identified during site preparation and construction, these effects can be reduced to acceptable levels by selecting an appropriate mitigation, revising the facility design, or modifying operating procedures.

This monitoring program will complement and integrate with other monitoring programs across the HAR site (e.g., hydrological monitoring, aquatic monitoring, meteorological monitoring), and monitoring programs conducted by the HNP, NCDENR, NCWRC, and other agencies to ensure data are consistent, comprehensive, and not duplicative in effort. The appropriate monitoring period will be determined after consultations with the appropriate resource agencies to ensure that potential effects to ecological systems and biota at the HAR site have been sufficiently identified, and mitigation measures implemented.

Pre-operational monitoring will consist of sampling plant and animal communities on an annual basis to determine and denote changes in species composition and abundance to ensure controls are in place and working effectively. A detailed description of pre-operational monitoring can be found in Subsection 6.5.1.3 and is summarized in Table 6.7-9.

A Phase I archaeological investigation will be conducted. In addition, a follow-up investigation pursuant to Section 106 of the NHPA, cultural resource assessment, will be conducted (Reference 6.7-006).

6.7.5.1.4 Operational Monitoring

Operational monitoring will consist of specific permit requirements, such as air and effluent monitoring, and be specific to NPDES and CWA permit requirements. Monitoring in these areas will be coordinated with existing monitoring efforts being performed by the HNP, NCDENR, DWQ, and other applicable groups or agencies. A detailed description of operational monitoring can be found in Subsection 6.5.1.4 and is summarized in Table 6.7-9.

6.7.5.2 Water Quality and Aquatic Life Monitoring

The proposed aquatic monitoring program for HAR 2 and HAR 3 is designed to overlap the proposed hydrological monitoring program to establish background conditions for surface water and groundwater before construction and operation (Section 6.3).

6.7.5.2.1 Pre-Application Monitoring Program

The HNP site implemented a monitoring program to assess the overall water quality of Harris Reservoir, identify any natural or power plant–induced effects on reservoir water quality, document the introduction and expansion of non-native plant and animal populations in the reservoir, and document the status of the recreational fishery. In addition to monitoring programs undertaken by HNP, the DWQ has performed monitoring of Harris Reservoir under the ALMP (Section 6.1) (Reference 6.7-007).

A pre-application field investigation was conducted by biologists to take into account potential inundation effects that could adversely affect streams and aquatic organisms as a result of construction activities at the HAR site. Field observations indicated that several wetland areas and streams lie within the 67.1 and 73.2 m (220 and 240 ft.). A discussion of wetlands can be found in Subsection 2.4.2.2 (Reference 6.7-008).

A detailed description of pre-application aquatic monitoring can be found in Subsection 6.5.2.1 and is summarized in Table 6.7-10.

6.7.5.2.2 Site Preparation and Construction Monitoring Program

Dredging and construction work will require permits from the USACE. Construction and operational monitoring, as well as monitoring of wetland areas created for mitigation purposes, will be designed in accordance with CWA 404/401 permit requirements (Reference 6.7-009). Additional monitoring will be conducted after construction to determine effects of water withdrawal in the Cape Fear River. A detailed description of construction monitoring can be found in Subsection 6.5.2.2 and is summarized in Table 6.7-10.

6.7.5.2.3 Pre-Operational Monitoring Program

Continued implementation of pre-application monitoring will provide data necessary to assess alterations of surface water flow fields in Harris Reservoir (namely the cooling loop), sediment transport, floodplains, or wetlands. The program may be modified based on the evaluation of monitoring data and other information collected for the operation of HAR 2 and HAR 3. Monitoring in compliance with the CWA 404/401 permits may be required for any dredging activities occurring on the Cape Fear River depending on permit stipulations and discussions with the resource agencies (Reference 6.7-009).

A detailed description of pre-operational aquatic monitoring can be found in ER Subsection 6.5.2.3 and is summarized in Table 6.7-10.

6.7.5.2.4 Operational Monitoring Program

Operational monitoring for Harris Reservoir will be designed to identify effects from the operation of HAR 2 and HAR 3. Monitoring may be modified based on consultations with the NCDENR and the HNP. Data from this program will be evaluated to determine changes in the cooling system flows, water levels in Harris Reservoir, and discharges from Harris Reservoir to Buckhorn Creek.

The monitoring plan is addressed in Section 6.3. Specific monitoring requirements will be designed after consultation with resource agencies to meet conditions of the CWA 316b permit to minimize adverse environmental effects (Reference 6.7-010).

The Cape Fear River will be monitored during operation to ensure that water withdrawal remains within operating parameters. Details of the monitoring plan are addressed in Section 6.3.

Wetlands would be delineated and regulatory status determined according to CWA 404/401permit requirements; regulated wetlands would be mitigated in accordance with these permit requirements. Stream and channel crossings will be monitored following construction to ensure that adequate restoration has been implemented (Reference 6.7-009).

A detailed description of operational aquatic monitoring can be found in Subsection 6.5.2.4 and is summarized in Table 6.7-10.

6.7.6 CHEMICAL MONITORING

The objective of the chemical monitoring program will be to identify environmental effects, including the potential degradation of water quality caused by the development and construction of HAR 2 and HAR 3, and to identify alternatives or engineering measures that could be used to reduce any adverse effects that may be identified. The chemical monitoring program for the HAR 2 and HAR 3 COL will include the following:

6.7.6.1 Pre-Application Monitoring Program

Water samples were collected in streams, lakes, and impoundments to establish background water quality conditions, and support the chemical descriptions presented in ER Subsection 2.3.3. The monitoring stations used for the NEMP and NPDES programs are shown in Section 6.1, Figure 6.1-1 (Reference 6.7-011).

Water samples were collected concurrently with thermal measurements, as specified in Section 6.1. Chemical data obtained from these locations were used to monitor the conditions in Harris Reservoir, Buckhorn Creek, and the Cape Fear River. The final list of analytical parameters included in the chemical monitoring program is anticipated to be similar to that monitored for the HNP, and a summary of those parameters is contained in Table 6.6-1. HAR monitoring activities will be coordinated with HNP monitoring activities to ensure no disruption of ongoing operational issues.

The pre-application monitoring program for groundwater quality was implemented to support the assessment of site acceptability. In addition, the results obtained were used to identify the groundwater quality effects that could result from construction and operation of the HAR. The existing chemical database is sufficient to support the description of the groundwater system characteristics near HAR 2 and HAR 3 (Subsection 6.6.1.3).

6.7.6.2 Site Preparation, Construction, and Pre-Operational Monitoring Program

Chemical monitoring of surface water and groundwater will be conducted to provide data necessary to assess water quality changes that result from site preparation, construction, and operation of HAR 2 and HAR 3. The objective is to characterize the water quality at the site, and provide a baseline for the identification and measurement of water quality changes from operation of HAR 2 and HAR 3. The frequency and duration of this monitoring program will be determined through permit requirements and consultations with the appropriate resource agencies. The construction and pre-operational monitoring of Buckhorn Creek and the Cape Fear River will be an extension of the pre-application monitoring until HAR 2 and HAR 3 are operational. A detailed description of pre-operational monitoring can be found in Subsection 6.6.2 and is summarized in Table 6.6-1.

6.7.6.3 Operational Monitoring Program

Operational monitoring will be conducted to establish any chemical effects to surface water and groundwater that could result from facility operation. A consideration in the development of the operational monitoring program is the ability to update the estimates of the effectiveness of various effluent treatment

systems, and provide real time warnings of any failures in the effluent treatment systems.

Specific elements for the assessment of surface water quality will be developed in consultation with the NCDENR, relative to NPDES permit requirements (renewal) and with consideration of monitoring presently being conducted for the HNP. The operational monitoring program is anticipated to extend over the span of the issued NPDES permit (5-year permit issuance cycle), depending on specified permit conditions, or until conditions appear to have stabilized as verified by statistical analyses and professional judgment. If water quality trends for specific parameters demonstrate no significant changes throughout the monitoring project, analysis of those parameters may be reduced or deleted from the monitoring program, depending on the parameter and its environmental importance. A more detailed description of operational monitoring can be found in Subsection 6.6.3 and is summarized in Table 6.6-1.

Groundwater data from the pre-application, construction, and pre-operational sampling events will be evaluated, and the scope and/or the frequency of chemical monitoring will be modified, as needed.

6.7.6.4 Environmental Monitoring Program Quality Assurance and Quality Control Program

All data collected will be completed in the field and laboratory to comply with all standard QA/QC procedures. QA and QC samples will include field blanks, equipment blanks, trip blanks, field duplicates, and matrix spike/matrix spike duplicate samples. All data will be collected in a non-biased fashion and verified prior to analysis.

6.7.7 REFERENCES

6.7-001 North Carolina Environmental Management Commission, “Report to the Environmental Review Commission on the Status of Water Quality in Water Supply Reservoirs Sampled by the Division of Water Quality,” April 2006.

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6.7-011 North Carolina Environmental Management Commission, "Report to the Environmental Review Commission on the Status of Water Quality in Water Supply Reservoirs Sampled by the Division of Water Quality," April 2006 in Progress Energy Carolinas, Inc. (PEC), Applicant's Environmental Report—License Renewal Operating Stage Shearon Harris Nuclear Plant, Unit 1, Docket No. 50-400, License No. NPF-63, Appendix C, June 2006.

Table 6.7-1
Summary Describing Combined Monitoring Programs

Table Number	Table	Measurement Description
6.7-2	Summary of Proposed Thermal, Physical, and Water Quality Monitoring Programs for Proposed HAR 2 and HAR 3	Objectives of program, sites monitored, frequency, field parameters, water quality parameters, collection points for field and water quality parameters, and data analysis.
6.7-3	Radiological Environmental Sampling Locations by Sample Type	Sample type, station number and location, frequency, sample size, and analysis.
6.7-4	Media Used to Assess Exposure Pathways to Humans	Pathway exposure to man, and media sampled by way of external dose, ingestion, and inhalation.
6.7-5	Radiological Environmental Sampling Locations Legend by HNP Station Number	HNP station number and sample type.
6.7-6	Summary of Proposed Hydrological Monitoring Program for Proposed HAR 2 and HAR 3	Objectives of sampling program, wells monitored, frequency, field parameters, water quality parameters, collection points for field and water quality parameters, and data analysis.
6.7-7	HNP Meteorological Monitoring Tower, Meteorological Sensor Elevations	Wind speed and direction, dew point, solar radiation, ambient temperature, delta temperature, precipitation, and barometric pressure.
6.7-8	HNP Meteorological Monitoring Tower, Accuracy of Monitored Parameters	Basis and accuracy criteria for wind direction, wind speed, ambient temperature, differential temperature, wet-bulb temperature, and relative humidity/dew point.
6.7-9	Terrestrial Ecology Monitoring	Summary of four phases of HAR 2 and HAR 3 project: terrestrial field investigations and surveys for terrestrial flora and fauna, sensitive habitat and species of interest, historical properties, commercial game lands, coordination with federal and state agencies and other special interest groups.
6.7-10	Aquatic Ecology Monitoring	Summary of four phases of HAR 2 and HAR 3 project: aquatic investigations and sampling for aquatic flora and fauna, sensitive habitat and species of interest, commercial fishery, coordination with federal and state agencies and other special interest groups.
6.6-1	Summary of Proposed Groundwater Chemical Monitoring Program for HAR 2 and HAR 3	Objective of sampling program, wells monitored, frequency, field parameters, water quality parameters, collection points for field and water quality parameters, and data analysis.

Table 6.7-2 (Sheet 1 of 2)
Summary of Proposed Thermal, Physical, and Water Quality Monitoring Programs for Proposed HAR 2 and HAR 3

Description	Pre-Application[a]	Pre-Operational	Operational
Objective of sampling program	Establish background water quality in Harris Reservoir, Buckhorn Creek, and the Cape Fear River before site preparation and construction activities.	Establish baseline and document water quality changes during site preparation and construction activities.	Document water quality changes during operation.
Sites monitored	E2, H2, P2, S2[b], BK2[c], and D2[c] (Figure 6.1-1)	E2, H2, P2, S2, V3[d] MP1[d], MP2[d], MP3[d], BK2[c], and D2[c] (Figure 6.1-1)	E2, H2, P2, S2, V3[d] MP1[c], MP2[d], MP3[d], BK2[c], and D2[c] (Figure 6.1-1)
Frequency	E2, H2, P2, and S2[b]: Quarterly BK2[c] and D2[c]: Monthly	Bi-monthly beginning approximately 1 year before site preparation activities (increase frequency if notable changes occur).	Monthly (for 2 years), bi-monthly (for 3 years), and quarterly thereafter.
Field parameters	Water temperature[e] DO pH Turbidity Specific conductance Water clarity Depth-to-bottom	Water temperature[e] DO pH Turbidity Specific conductance Water clarity Depth-to-bottom	Water temperature[e] DO pH Turbidity Specific conductance Water clarity Depth-to-bottom
Collection points for field parameters	Surface (0.2 m) and then surface to bottom at 1-m (3.3-ft.) depth intervals.	Surface (0.2 m) and then surface to bottom at 1-m (3.3-ft.) depth intervals.	Surface (0.2 m) and then surface to bottom at 1-m (3.3-ft.) depth intervals.
Water quality parameters	**General Water Chemistry** Alkalinity, total Ammonia-N Chloride Hardness Nitrate + Nitrite-N Total Kjeldahl Nitrogen (TKN) Phosphorous, total Sulfate Total dissolved solids Total organic carbon	**General Water Chemistry** Alkalinity, total Ammonia-N Chloride Hardness Nitrate + Nitrite-N TKN Orthophosphate[f] Phosphorous, total Sulfate Sulfide[f] Total dissolved solids Total organic carbon Total solids Total suspended solids[f]	**General Water Chemistry** Alkalinity, total Ammonia-N Chloride Hardness Nitrate + Nitrite-N TKN Orthophosphate[f] Phosphorous, total Sulfate Sulfide[f] Total dissolved solids Total organic carbon Total solids Total suspended solids[f]

Table 6.7-2 (Sheet 2 of 2)
Summary of Proposed Thermal, Physical, and Water Quality Monitoring Programs for Proposed HAR 2 and HAR 3

Description	Pre-Application[a]	Pre-Operational	Operational
Water quality parameters *(Continued)*	**Biological** Chlorophyll *a*	**Biological** Chlorophyll *a* Biological Oxygen Demand[f] Chemical Oxygen Demand[f]	**Biological** Chlorophyll *a* Biological Oxygen Demand[f] Chemical Oxygen Demand[f]
	Metals Calcium Copper Magnesium Manganese Sodium	**Metals** Arsenic[f] Boron[f] Calcium Copper Chromium[f] Iron[f] Lead[f] Magnesium Manganese Mercury[f] Nickel[f] Potassium[f] Sodium Zinc[f]	**Metals** Arsenic[f] Boron[f] Calcium Copper Chromium[f] Iron[f] Lead[f] Magnesium Manganese Mercury[f] Nickel[f] Potassium[f] Sodium Zinc[f]
Collection points for water quality parameters	0.2 m (0.7 ft.) below surface for all surface water sample locations. For lake monitoring stations only, also collect samples from within 1 m (3.3 ft.) of the lake bottom.	0.2 m (0.7 ft.) below surface for all surface water sample locations. For lake monitoring stations only, also collect samples from within 1 m (3.3 ft.) of the lake bottom.	0.2 m (0.7 ft.) below surface for all surface water sample locations. For lake monitoring stations only, also collect samples from within 1 m (3.3 ft.) of the lake bottom.
Data analysis	Statistical trend analysis	Statistical trend analysis	Statistical trend analysis

Notes:
a) Historical information collected from the HNP, Nonradiological Annual Environmental Monitoring Reports, 1983 through current, and grab samples from identified locations.

b) Monitoring Station S2 was not sampled from 1984 through 1988 for the Nonradiological Environmental Monitoring Program.

c) Monitoring Stations BK2 and D2 are added to the existing water sampling locations for the Pre-Application, Pre-Operational, and Operational Monitoring Programs.

d) Monitoring Stations V3, MP1, MP2, and MP3 are added to the existing water sampling locations for the Pre-Operational and Operational Monitoring Programs.

e) The temperature measurements at each site are collected at consistent depths and at a time of day (morning) that minimizes the effect of diurnal solar warming.

f) Parameter added to the existing water quality list for the Pre-Operational and Operational Monitoring Programs.

Table 6.7-3 (Sheet 1 of 3)
Radiological Environmental Sampling Locations by Sample Type

Sample Type	Station Number and Location	Frequency	Sample Size	Analysis
Air Cartridge (AC)	1 – 4.1 km (2.6 mi.) N 2 – 2.2 km (1.4 mi.) NNE 4 – 4.9 km (3.1 mi.) NNE 5 – 21.4 km (13.4 mi.) WNW – Pittsboro[a] 26 – 7.5 km (4.7 mi.) S 47 – 5.4 km (3.4 mi.) SSW	As required because of dust loading, but at a minimum every 7 days	275 m^3 (9712 ft^3)	Iodine-131
Air Particulate (AP)	1 – 4.1 km (2.6 mi.) N 2 – 2.2 km (1.4 mi.) NNE 4 – 4.9 km (3.1 mi.) NNE 5 – 21.4 km (13.4 mi.) WNW – Pittsboro[a] 26 – 7.5 km (4.7 mi.) S 47 – 5.4 km (3.4 mi.) SSW	As required because of dust loading but at a minimum every 7 days	275 m^3 (9712 ft^3)	Gross Beta (Weekly) Composite Gamma (Quarterly)
Fish (FH)	44 – Site varies in Harris Reservoir 45 – Site varies in the Cape Fear River above Buckhorn Dam[a]	Semi-annual	1 kg (2.2 lb.) (wet) Free Swimmers and Bottom Feeders	Gamma
Drinking Water (DW)	38 – 9.9 km (6.2 mi.) WSW[a] 40 – 27.5 km (17.2 mi.) SSE – Lillington 51 – Water Treatment Plant (on-site)	2-Week Composite Monthly Composite Quarterly Composite	8 L (2.1 gal.)	Iodine-131, Gamma, Tritium, Gross Alpha, Gross Beta
Ground-water (GW)	39 – 1.1 km (0.7 mi.) SSW 57 – 0.6 km (0.4 mi.) SSW 58 – 0.8 km (0.5 mi.) WSW 59 – 0.8 km (0.5 mi.) NNE 60 – 0.8 km (0.5 mi.) ESE	Quarterly	4 L (1.1 gal.)	Gamma, Tritium
Milk (MK)	5 – 29.1 km (18.2 mi.) WNW – Manco Dairy[a]	Semi-monthly	8 L (2.1 gal.)	Iodine-131, Strontium-90, Gamma
Shoreline Sediments (SS)	26 – 7.4 km (4.6 mi.) S 41 – 6.0 km (3.8 mi.) S	Semi-annual	500 g (17.6 oz.)	Gross Beta, Gross Alpha, Strontium-90, Gamma

Table 6.7-3 (Sheet 2 of 3)
Radiological Environmental Sampling Locations by Sample Type

Sample Type	Station Number and Location	Frequency	Sample Size	Analysis
Surface Water (SW)	26 – 7.5 km (4.7 mi.) S 38 – 9.9 km (6.2 mi.) WSW[(a)] 40 – 27.5 km (17.2 mi.) SSE – Lillington	Weekly/ Monthly/ Quarterly Composite	8 l (2.1 gal.)	Iodine-131, Gamma Isotopic, Tritium, Gross Alpha, Gross Beta
Aquatic Vegetation (AV)	26 – 7.5 km (4.7 mi.) S 41 – 6.0 km (3.8 mi.) S 61 – 4.0 km (2.5 mi.) E	Annually	500 g (17.6 oz.)	Gamma
Bottom Sediment (SD)	52 – 6.0 km (3.8 mi.) S	Semi-annual	500 g (17.6 oz.)	Gamma
Food Crops (FC) or Food Products (FP)	5 – 28.8 km (18.0 mi.) NNW – Pittsboro[(a)] 54 – 2.7 km (1.7 mi.) NNE – Wilkins or Morris 55 – 3.2 km (2.0 mi.) NNW – L.L. Goodwin 62 – 3.7 km (2.3 mi.) NE – Lee 64 – 2.9 km (1.8 mi.) ENE – Michael	Three different kinds of broadleaf vegetation monthly during the growing season	500 g (17.6 oz.)	Gamma
Broadleaf Vegetation (BL)	65 – 2.2 km (1.4 mi.) S – Site Boundary 66 – 2.1 km (1.3 mi.) SSW – Site Boundary 5 – 19.2 km (12.0 mi.) NNW – Pittsboro[(a)]	Monthly	500 g (17.6 oz.)	Gross Beta, Gamma, Iodine-131.
Thermo-luminescent Dosimetry (TL or TLD)	1 – 4.1 km (2.6 mi.) N 1 – 4.1 km (2.6 mi.) N 2 – 2.2 km (1.4 mi.) NNE 3 – 3.0 km (1.9 mi.) ENE 4 – 4.9 km (3.1 mi.) NNE 5 – 21.4 km (13.4 mi.) WNW – Pittsboro[(a)] 6 – 1.3 km (0.8 mi.) NE 7 – 1.1 km (0.7 mi.) E 8 – 1.0 km (0.6 mi.) ESE 9 – 3.5 km (2.2 mi.) SE	Quarterly	Not Applicable	TLD Reading

Table 6.7-3 (Sheet 3 of 3)
Radiological Environmental Sampling Locations by Sample Type

Sample Type	Station Number and Location	Frequency	Sample Size	Analysis
	10 – 3.5 km (2.2 mi.) SSE 11 – 1.0 km (0.6 mi.) S 12 – 1.4 km (0.9 mi.) SSW 13 – 1.1 km (0.7 mi.) WSW 14 – 2.4 km (1.5 mi.) W 15 – 3.2 km (2.0 mi.) W 16 – 3.0 km (1.9 mi.) WNW 17 – 2.4 km (1.5 mi.) NW 18 – 2.2 km (1.4 mi.) NNW 19 – 8.0 km (5.0 mi.) NNE 20 – 7.2 km (4.5 mi.) NE 21 – 7.7 km (4.8 mi.) ENE 22 – 6.9 km (4.3 mi.) E 23 – 7.7 km (4.8 mi.) ESE 24 – 6.4 km (4.0 mi.) SE 25 – 7.5 km (4.7 mi.) SSE 26 – 7.5 km (4.7 mi.) S 27 – 7.7 km (4.8 mi.) SW 28 – 7.7 km (4.8 mi.) SSW 29 – 9.1 km (5.7 mi.) WSW 30 – 8.9 km (5.6 mi.) W 31 – 7.5 km (4.7 mi.) WNW 32 – 10.2 km (6.4 mi.) NNW 33 – 7.2 km (4.5 mi.) NNW 34 – 13.9 km (8.7 mi.) NE – Apex 35 – 11.0 km (6.9 mi.) E – Holly Springs 36 – 17.4 km (10.9 mi.) E 37 – 14.7 km (9.2 mi.) ESE – Fuquay-Varina 48 – 7.2 km (4.5 mi.) N 49 – 4.0 km (2.5 mi.) NNE 50 – 4.1 km (2.6 mi.) ESE 53 – 9.3 km (5.8 mi.) NW 56 – 4.8 km (3.0 mi.) WSW 63 – 1.0 km (0.6 mi.) SW 67 – 1.9 km (1.2 mi.) ENE			

Source: Reference 6.7-002

Table 6.7-4
Media Used to Assess Exposure Pathways to Humans

Pathway Exposure to Humans	Media Sampled
External Dose	Thermoluminescent Dosimetry (TLD)
	Shoreline Sediments (SS)
Ingestion	Aquatic Vegetation (AV)
	Drinking Water (DW)
	Food Crops (FC)
	Fish (FH)
	Groundwater (GW)
	Milk (MK)
	Broadleaf Vegetation (when milk samples are unavailable) (BL)
	Surface Water (SW)
Inhalation	Air Samples (Particulate and Iodine)

Source: Reference 6.7-002

Table 6.7-5
Radiological Environmental Sampling Locations Legend by HNP Station Number

HNP Station Number	Sample Type	Figure 6.2-2 Sheet:	HNP Station Number	Sample Type	Figure 6.2-2 Sheet:
1	AP, AC, TL	3	35	TL	2
2	AP, AC, TL	3	36	TL	2
3	TL	3	37	TL	2
4	AP, AC, TL	3	38	SW, DW	2
5	AP, AC, MK, FC, TL, BL	1	39	GW	3
6	TL	3	40	SW, DW	2
7	TL	3	41	SS, AV	3
8	TL	3	42	MK	2
9	TL	3	43	DELETED	---
10	TL	3	44	FH	3
11	TL	3	45	FH	1
12	TL	3	46	DELETED	---
13	TL	3	47	AP, AC	3
14	TL	3	48	TL	2
15	TL	3	49	TL	3
16	TL	3	50	TL	3
17	TL	3	51	DW	3
18	TL	3	52	SD	3
19	TL	2	53	TL	1
20	TL	2, 3	54	FC	3
21	TL	2	55	FC	3
22	TL	2	56	TL	3
23	TL	2	57	GW	3
24	TL	2	58	GW	3
25	TL	2, 3	59	GW	3
26	AP, AC, AV, SS, SW, TL	2, 3	60	GW	3
27	TL	2, 3	61	AV	2
28	TL	2, 3	62	FC	3
29	TL	1	63	TL	3
30	TL	1	64	FC	3
31	TL	1	65	BL	3
32	TL	1	66	BL	3
33	TL	2	67	TL	3
34	TL	2			

Source: Reference 6.7-002

Table 6.7-6 (Sheet 1 of 2)
Summary of Proposed Hydrological Monitoring Program for Proposed HAR 2 and HAR 3

Description	Pre-Application	Pre-Operational	Operational
Objective of sampling program	Establish background water quality in groundwater at the COL site before pre-construction and construction activities.	Establish baseline and document water quality changes during pre-construction and construction activities.	Document water quality changes during operation.
Wells monitored	MWA-4S, -4D, -7S, -7D, -9S, and -9D	MWA-2S, -7S, and -12, W-13/GW-59, LP-6, LP-7, LP-9, LP-16, and WAD-1/GW-39	MWA-2S, -7S, and -12, W-13/GW-59, LP-6, LP-7, LP-9, LP-16, WAD-1/GW-39, and one additional well
	(Figure 6.6-1)	(Figure 6.6-2)	(Figure 6.6-2)
Frequency	As needed for background.	Quarterly beginning about 1 year before pre-construction activities (increase frequency if notable changes occur).	Quarterly
Field parameters	Water temperature DO pH Turbidity Specific conductance	Water temperature DO pH Turbidity Specific conductance	Water temperature DO pH Turbidity Specific conductance
Collection of field parameters	With a flow-through cell after purging activities.	With a flow-through cell after purging activities.	With a flow-through cell after purging activities.
Water quality parameters	**General Water Chemistry** Alkalinity, total Ammonia-N Bicarbonate Carbon Dioxide Chloride Hardness Nitrate + Nitrite-N Total Kjeldahl Nitrogen (TKN) Orthophosphate Phosphorous, total Sulfate Sulfide Total dissolved solids Total organic carbon Total suspended solids	**General Water** Chemistry Alkalinity, total Ammonia-N Bicarbonate Carbon Dioxide Chloride Hardness Nitrate + Nitrite-N TKN Orthophosphate Phosphorous, total Sulfate Sulfide Total dissolved solids Total organic carbon Total suspended solids	**General Water** Chemistry Alkalinity, total Ammonia-N Bicarbonate Carbon Dioxide Chloride Hardness Nitrate + Nitrite-N TKN Orthophosphate Phosphorous, total Sulfate Sulfide Total dissolved solids Total organic carbon Total suspended solids

Table 6.7-6 (Sheet 2 of 2)
Summary of Proposed Hydrological Monitoring Program for Proposed HAR 2 and HAR 3

Description	Pre-Application	Pre-Operational	Operational
Water quality parameters	**Biological** Biological Oxygen Demand Chemical Oxygen Demand **Metals** Arsenic Boron Calcium Chromium, total Copper Iron Lead Magnesium Manganese Mercury Nickel Potassium Silica Sodium Zinc	**Biological** Biological Oxygen Demand Chemical Oxygen Demand **Metals** Arsenic Boron Calcium Chromium, total Copper Iron Lead Magnesium Manganese Mercury Nickel Potassium Silica Sodium Zinc	**Biological** Biological Oxygen Demand Chemical Oxygen Demand **Metals** Arsenic Boron Calcium Chromium, total Copper Iron Lead Magnesium Manganese Mercury Nickel Potassium Silica Sodium Zinc
Sample collection for water quality parameters	Purged groundwater within screened interval of well.	Purged groundwater within screened interval of well.	Purged groundwater within screened interval of well.
Data analysis	Statistical trend analysis	Statistical trend analysis	Statistical trend analysis

Table 6.7-7
HNP Meteorological Monitoring Tower
Meteorological Sensor Elevations

Sensor	Elevation Above Tower Base (meters)
Wind Speed and Direction	12.5 and 61.4
Dew Point	11.0
Solar Radiation	1.5
Ambient Temperature	11.0 and 59.9
Delta-Temperature (two channels)[a]	11.0 and 59.9
Precipitation	1.5
Barometric Pressure	1.5

Notes:
a) Used to measure differential temperature channel between these elevations.

Source: Reference 6.7-004

Table 6.7-8 (Sheet 1 of 2)
HNP Meteorological Monitoring Tower
Accuracy of Monitored Parameters[(a)]

Monitored Parameter	Basis	Accuracy Criteria
Wind Sensor:		
Wind Direction	NRC Regulatory Guide 1.23, Revision 1	±5 °C (±0.9°F). Starting threshold <0.45 m/s (1 mph). Resolution to 1.0°.
	NRC Regulatory Guide 1.97, Revision 3	Range: 0° to 360° ±5°C (0 - ±0.9°F) accuracy with a deflection of 10°. Starting threshold less than 0.4 m/s (1 mph). Damping ratio greater than or equal to 0.4. Delay distance less than or equal to 2 m (6.6 ft.)
Wind Speed	NRC Regulatory Guide 1.23, Revision 1	±0.2 m/s (±0.45 mph) or 5% of observed wind speed. Starting threshold <0.45 m/s (1 mph). Resolution to 0.1 m/s or 0.1 mph.
	NRC Regulatory Guide 1.97, Revision 3	Range: 0 to 44 m/s (100 mph); ±0.2 m/s (0.5 mph) for speeds less than 2 m/s (5 mph); ±10% for speed in excess of 2 m/s (5 mph). Starting threshold of less than 0.4 m/s (1.0 mph). Distance constant not to exceed 2 m (HNP Exception: Distance constant for installed instrument is 2.1 m).
Ambient Temperature	NRC Regulatory Guide 1.23, Revision 1	±0.5°C (±0.9 °F). Resolution to 0.1°C (0.1°F).
Differential Temperature	NRC Regulatory Guide 1.23, Revision 1	±0.1°C (±0.18°F). Resolution to 0.01°C (0.01°F).
	NRC Regulatory Guide 1.97, Revision 3	±0.15°C per 50 m (±0.3°F per 164 ft.) for time-averaged values.
Wet-Bulb Temperature	NRC Regulatory Guide 1.23, Revision 1	±0.5°C (±0.9°F). Resolution to 0.1°C (0.1°F).
Relative Humidity/Dew Point	NRC Regulatory Guide 1.23, Revision 1	Relative Humidity: ±4% Resolution to 0.1%.
		Dew Point: ±1.5°C (±2.7°F). Resolution to 0.1°C (0.1°F).

Notes:
m/s = meters per second
mph = miles per hour

Source: Reference 6.7-004

Table 6.7-8 (Sheet 2 of 2)
HNP Meteorological Monitoring Tower
Accuracy of Monitored Parameters[a]

Monitored Parameter	Basis	Accuracy Criteria
Relative Humidity/Dew Point *(Continued)*	ANSI/ANS 2.5-1984[b]	Equivalent to Dew Point Accuracy of 1.5°C where relative humidity is in excess of 60% and temperature is between -30°C and +30°C. Resolution to 0.1°C.
Total Precipitation	NRC Regulatory Guide 1.23, Revision 1	Precipitation (water equivalent). ±10% for a volume equivalent to 2.54 mm (0.1 in.) of precipitation at a rate <50 mm/h (<2 in./h). Resolution to 0.25 mm (0.01 in.)
	ANSI/ANS 2.5-1984	Resolution of 0.25 mm (0.01 in.); ± 10% of total amounts > 0.2 in.
Solar Radiation	ANSI/ANS 2.5-1984	Consistent with current state-of-the-art.
Barometric Pressure	ANSI/ANS 2.5-1984	Consistent with current state-of-the-art
Time	NRC Regulatory Guide 1.23, Revision 1	±5 min. Resolution to ±1 min.

Notes:
a) The HNP meteorological parameters monitored on the tower satisfy the indicated criteria, with exceptions as noted. Parameter accuracy based on NRC Regulatory Guide 1.23, Revision 1 and NRC Regulatory Guide 1.97, Revision 3 are base HNP commitments, while the American National Standards Institute/American Nuclear Society (ANSI/ANS) 2.5-1984 guidance reflects industry and regulator-accepted state-of-the-art specifications.

b) There are no accuracies specified in RG 1.23 for these parameters. ANSI/ANS 2.5-1984 guidance reflects industry and regulator-accepted state-of-the-art specifications.

Source: Reference 6.7-004

Table 6.7-9 (Sheet 1 of 4)
Terrestrial Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
HAR Site	Field investigations conducted in August 2006 to observe habitat and species abundance. Habitat survey conducted by USFWS (no areas within the HAR site are designated by the USFWS as critical habitat for federally threatened or endangered species).	Runoff and sediment transport to adjacent areas, as defined in the NPDES permit.	Runoff and sediment transport to adjacent areas, as defined in the NPDES permit.	Runoff and sediment transport to adjacent areas, as defined in the NPDES permit.
Harris Reservoir Perimeter	Self assessments conducted by the HNP and CP&L to determine species composition and relative abundance within the HNP vicinity. Surveys of forest communities and environmentally sensitive areas around perimeter of Harris Reservoir. August 2006 field investigations to characterize habitats that occur between elevations of 67 and 73 m (220 and 240 ft.) surrounding Harris Reservoir. North Carolina State University monitoring of Harris Research Tract. Field investigations conducted in August 2006 to identify wetlands, and observe habitat and species abundance. Archaeological investigation of the HAR site in fall 1978, Archaeological reconnaissance and geomorph investigation of inundation area surrounding Harris Reservoir. Habitat survey conducted by USFWS	Build on existing programs established by HNP/CP&L and other agency monitoring programs, as required by specific permit conditions: 1) Before construction, and annually thereafter, conduct surveys for target species (bald eagle, red cockaded woodpecker) 2) Before construction, conduct survey around perimeter of Harris Reservoir to identify target areas for relocation of native plants. Then, sample plant communities on an annual basis to determine and denote changes in species composition and abundance in the vicinity to ensure controls are in place and working effectively. 3) Wetland delineation in accordance with USACE guidelines and mitigation measures implemented in accordance with CWA-404/401 permit requirements. 4) Appropriate timing of construction activities to accommodate the life cycles of less mobile species.	Build on existing programs established by HNP/CP&L and other agencies, and site preparation and construction monitoring, as required by specific permit conditions: 1) Sample plant communities on an annual basis to determine and denote changes in species composition and abundance in the vicinity to ensure controls are in place and working effectively. 2) Conduct yearly surveys to determine species composition, distribution, and relative abundance of bird species present during migratory and nesting periods; 3) Conduct yearly surveys of waterfowl at Harris Reservoir and other waterbodies within the vicinity, as appropriate, to confirm that changes in composition, abundance, or distribution are not occurring.	Build on existing programs established by HNP, site preparation and construction, and pre-operational monitoring, as required by specific permit conditions: 1) Sample plant communities on an annual basis to determine and denote changes in species composition and abundance in the vicinity to ensure controls are in place and working effectively. 2) Conduct yearly surveys to determine species composition, distribution, and relative abundance of bird species present during migratory and nesting periods; 3) Conduct yearly surveys of waterfowl at Harris Reservoir and other waterbodies within the vicinity, as appropriate, to confirm that changes in composition, abundance, or distribution are not occurring.

Table 6.7-9 (Sheet 2 of 4)
Terrestrial Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
Harris Reservoir Perimeter (cont.)	(no areas within the HAR site are designated by the USFWS as critical habitat for federally threatened or endangered species).	5) Monitor erosion to verify controls minimizing sediment deposition are in place and adjacent ecosystems are not being affected during timber removal. 6) Monitor area surrounding the HAR site for species of interest that will occur in or near areas of effect. The USFWS will be contacted to confirm the presence or absence of any federally listed (or proposed for listing) threatened or endangered animals. 7) Monitor effects to habitat buffers and wetland areas for small mammals, reptiles, and amphibians to verify controls are in place and adjacent ecosystems are not being affected. 8) Conduct annual surveys of waterfowl at Harris Reservoir and other waterbodies within the vicinity, as appropriate, to confirm that changes in composition, abundance, or distribution are not occurring, as a result of site preparation or construction activities at the HAR facility. 9) Follow specific monitoring requirements for construction and operation activities affecting wetlands, floodplains, and other natural areas that will require monitoring, as specified in the permits, or as designated by appropriate agencies.	4) Conduct annual surveys at specific locations within the vicinity to determine composition and abundance of small animal populations 5) Conduct annual field surveys at specific locations within the vicinity to observe species of interest or sensitive habitat. 6) Follow specific monitoring requirements for pre-operational activities affecting wetlands, floodplains, and other natural areas that require monitoring, as specified in the permits, or as designated by appropriate agencies. 7) Survey Harris Research Tract to ensure there is no effect to Michaux's sumac.	4) Conduct annual surveys at specific locations within the vicinity to determine composition and abundance of small animal populations 5) Conduct annual field surveys at specific locations within the vicinity to observe species of interest or sensitive habitat. 6) Follow specific monitoring requirements for operational activities affecting wetlands, floodplains, and other natural areas that will require monitoring, as specified in the permits, or as designated by appropriate agencies. 7) Survey Harris Research Tract to ensure there is no effect to Michaux's sumac.

Table 6.7-9 (Sheet 3 of 4)
Terrestrial Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
Harris Reservoir Perimeter (cont.)		10) Survey Harris Research Tract to ensure there is no effect to Michaux's sumac. 11) Perform Phase I archaeological investigation, followup investigations pursuant to Section 106 of the National Historic Preservation Act, cultural resource assessment.		
Cape Fear River Intake Structure and Pumphouse	CP&L/HNP survey assessments, field investigations, and data evaluation.	Monitoring will be required in accordance with the NPDES permit during construction to ensure appropriate controls are in place to prevent sedimentation of the Cape Fear River.	Monitoring performed in accordance with the NPDES permit to ensure appropriate controls are in place to prevent sedimentation of the Cape Fear River.	Monitoring performed in accordance with the NPDES permit to ensure appropriate controls are in place to prevent sedimentation of the Cape Fear River.
Makeup Water Pipeline Corridor	August 2006 evaluation to assess resources along the proposed corridor for the makeup water pipeline. Archaeological survey of proposed water makeup line corridor from the Cape Fear River to Harris Reservoir. Surveys of the North Carolina Game Lands.	Build on existing programs established by CP&L/HNP and other agency monitoring programs, as required by specific permit conditions: 1) Monitor for potential receptors and target species — additional monitoring will be needed, because this corridor also crosses North Carolina Game Lands. 2) Conduct seasonally appropriate surveys for several species of interest before any activities disturbing these species' habitats to ensure there are no negative effects.	Build on existing programs established by CP&L/HNP and other agencies, and site preparation and construction monitoring, as required by specific permit conditions: 1) Perform yearly monitoring for potential receptors and target species. 2) Conduct seasonally appropriate surveys for species of interest that inhabit areas and habitat types.	Build on existing programs established by HNP, site preparation and construction, and pre-operational monitoring, as required by specific permit conditions: 1) Perform yearly monitoring for potential receptors and target species. 2) Conduct seasonally appropriate surveys for species of interest that inhabit areas and habitat types. 3) Monitor pipeline to ensure erosion control measures are in place (i.e., effects from runoff are minimized and restoration activities are adequate and effective). 4) Monitor stream crossings yearly.

Table 6.7-9 (Sheet 4 of 4)
Terrestrial Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
Makeup Water Pipeline Corridor (cont.)		3) Perform monitoring of pipeline installation during construction and immediately following construction to ensure disturbance is minimized and erosion control measures are in place, ensuring effects from runoff are minimized and restoration activities are adequate and effective. 4) Monitor stream crossings yearly. 5) Ensure planning efforts associated with the pipeline corridor will take into consideration existing historic properties and consultation with the SHPO.	3) Monitor pipeline to ensure erosion control measures are in place (i.e., effects from runoff are minimized and restoration activities are adequate and effective). 4) Monitor stream crossings yearly.	
Transmission Lines	Previous CP&L/HNP survey assessments and field investigations for important habitats and/or species of interest. Surveys of the North Carolina Game Lands.	Once the precise routes of the three new transmission lines are selected, additional monitoring stations and procedures will be selected to identify and ensure that rare, threatened, and endangered species and sensitive natural areas are not affected by construction or operation of the HAR facility. Monitoring will be conducted, as required by specific permit conditions. Annual surveys of the North Carolina Game Lands, as required by specific permit conditions. Monitoring, as required by the NPDES (Construction Stormwater Discharge for Stand Alone Construction Projects) and possible CWA 404/401 permit.	Seasonally appropriate annual surveys conducted for species of interest that inhabit areas and habitat types bisected by current and proposed transmission lines will be conducted, as required by specific permit conditions. Annual surveys of the North Carolina Game Lands, as required by specific permit conditions.	Seasonally appropriate annual surveys conducted for species of interest that inhabit areas and habitat types bisected by current and proposed transmission lines will be conducted, as required by specific permit conditions. Annual surveys of the North Carolina Game Lands, as required by specific permit conditions.

Table 6.7-10 (Sheet 1 of 3)
Aquatic Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
HAR Site	The HNP site implemented a monitoring program as part of its ER; data have been collected under this program since 1972.	The primary focus of construction monitoring in this area will be related to runoff and sediment transport to adjacent areas as defined in the NPDES permit.	Monitoring will consist of specific permit requirements.	Monitoring will consist of specific permit requirements.
Harris Reservoir Perimeter	Water quality data collected under HNP ER site program since 1972. A stream-based pre-application biological assessment was conducted by biologists in August 2006 to verify and update the background conditions. Further water quality analyses were completed, utilizing the ecological health indicators of benthic macroinvertebrates and fish. North Carolina Division of Water Quality monitoring of Harris Reservoir performed under Ambient Lakes Monitoring Program.	Monitoring will be conducted as required by specific permit conditions. Examples are as follows: • Build on existing programs established by HNP/CP&L and other agency monitoring programs, and overlap with the proposed hydrological monitoring program to establish background conditions for surface water and groundwater before the construction and operation. • Water quality will be carefully monitored in stream channels and portions of Harris Reservoir with potential to be affected. • Monitoring as specified by applicable CWA 404 and Section 202, IEPA 401 Water Quality Certification, and NPDES permits; would include designing adequate sampling locations along stream and riparian zones to ensure controls are in place and working effectively. • The program will be modified, as needed, to ensure that further degradation of species abundance and diversity in these areas does not occur.	Monitoring will be conducted as required by specific permit conditions. Examples are as follows: • Build on existing programs established by HNP/CP&L and other agencies, site preparation and construction monitoring, and overlap with the hydrological monitoring program. • Additional locations and more frequent measurements during summer months will be incorporated into the monitoring program as the engineering design progresses. • Assess overall water quality of Harris Reservoir, identify any construction effects on reservoir water quality, document the introduction and expansion of nonnative plant and animal populations in the reservoir, and demonstrate the existence of a reasonable recreational fishery • The program will be modified as needed to ensure that further degradation of species abundance and diversity in these areas does not occur.	Monitoring will be conducted as required by specific permit conditions. Examples are as follows: • Build on existing programs, site preparation and construction, and pre-operational monitoring, and overlap with the hydrological monitoring program. • Assess overall water quality of Harris Reservoir, identify any natural or power plant-induced effects on reservoir water quality, document the introduction and expansion of nonnative plant and animal populations in the reservoir, and document the status of the recreational fishery. The program will be modified, as needed, to document existing conditions within the reservoir. • Coordinate efforts with NCDENR to monitor Harris Reservoir fisheries resources.

Table 6.7-10 (Sheet 2 of 3)
Aquatic Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
Cape Fear River Intake Structure and Pumphouse/ Cape Fear River	Twenty years of data from HNP ongoing monitoring efforts. The MCFRBA monitors the Cape Fear River annually.	Monitoring will be conducted as required by specific permit conditions. Examples are as follows: Before construction, survey tributaries of river for presence of federally endangered species. Coordinate effort with USFWS. Study for effects on water withdrawal. Water quality will be carefully monitored at the locations expected to be effected most heavily by construction. Monitoring will be required per the NPDES permit and CWA 404/401 permits during construction to ensure appropriate controls are in place to prevent sedimentation. All federal, state, local permit requirements for monitoring would be followed. Dredging and construction activities will require permits from USACE. All construction monitoring, as well as monitoring of wetland areas created for mitigation purposes, will be designed to CWA 404/401 permit requirements. Surveys for target species or state special concern species as required by specific permit conditions.	Pre-operational monitoring will be required per the NPDES permit and CWA 404 permit to ensure appropriate controls are in place. All federal, state, local permit requirements for monitoring would be followed. Pre-operational monitoring will be required per the NPDES permit and CWA 404/401 permits to ensure appropriate controls are in place. All federal, state, local permit requirements for monitoring would be followed.	Monitoring will be required per the NPDES permit during operations to ensure appropriate controls are in place to prevent sedimentation of the Cape Fear River. Major components of the evaluation will include in situ water quality measurements (DO, temperature, pH, specific conductance, and turbidity), habitat assessment, benthic macroinvertebrate community monitoring, and fish community monitoring at select stations along the river corridor. All operational monitoring, as well as monitoring of wetland areas created for mitigation purposes, will be designed to CWA 404/401 permit requirements. Potential monitoring to determine effects of water withdrawal on population dynamics in the Cape Fear River from the intake structure and pumphouse as required by specific permit conditions or consultations with resource agencies. Surveys for target species or state or federal rare, threatened, and endangered (RTE) species as required by specific permit conditions or consultations with resource agencies.

Table 6.7-10 (Sheet 3 of 3)
Aquatic Ecology Monitoring

	Pre-Application	Site Preparation and Construction	Pre-Operational	Operational
Makeup Water Pipeline Corridor	August 2006 evaluation to assess resources along the proposed corridor for the makeup water pipeline.	Monitoring will be conducted as required by specific permit conditions. Examples are as follows: Water quality will be carefully monitored at the locations expected to be effected most heavily by construction (small streams and wetland crossings). Annual surveys for target species or state special concern species.	Monitoring will be conducted as required by specific permit conditions. Examples are as follows: Monitoring of stream and channel crossings post-construction to ensure adequate restoration has been implemented. Annual surveys for target species or state special concern species.	Wetlands monitoring per CWA 404 /401 permit requirements. Annual surveys for target species or state special concern species as required by specific permit conditions.