Environmental Report for the GLE Commercial Facility

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PREPARED FOR:

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List of Acronyms

μCi	microcurie
μg	microgram
$\mu g/m^3$	micrograms per cubic meter
^{222}Rd	radon-222
^{226}Ra	radium-226
^{232}Th	thorium-232
^{235}U	uranium-235
^{238}U	uranium-238
^{40}K	potassium-40
7Q10	7-day, once in 10-year, low-flow discharge
AADT	annual average daily traffic
AAL	acceptable ambient level
AANE	Ambient Air Northeast
AAS	Ambient Air South
AASE	Ambient Air Southeast
ABWR	Advanced Boiling Water Reactors
ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
ACP	American Centrifuge Plant
ADT	average daily vehicle trips
ADU	ammonium diuranate
AE	Aircraft Engines
AEC	Area of Environmental Concern
AEP	annual exceedance probability
AERMOD	**A**MS/**E**PA **R**egulatory **Mod**el
agl	above ground level
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
AP1000	Westinghouse Pressurized Water Reactor
APE	Area of Potential Effect
ASOS	Automated Surface Observing System
ATC	Advanced Technology Center
AVLIS	Atomic Vapor Isotope Separation Process
bgs	below ground surface
BLM	Bureau of Land Management
BMP	best management practice

BOD	biochemical oxygen demand
bpf	blows per foot
CAA	Clean Air Act
CaF_2	calcium fluoride
CAMA	Coastal Area Management Act
CBA	cost-benefit analysis
CBG	Census Block Group
cDCE	cis-1,2 dichloroethylene
CDP	Census Designated Place
CEDE	committed effective dose equivalent
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
CH VFR	Castle Hayne Volunteer Fire & Rescue
CLERCA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
CNEIC	China Nuclear Energy Industry Corporation
CO	carbon monoxide
CO_2	carbon dioxide
cP	Continental Polar
CWA	Clean Water Act
Cy	calendar year
D/Q	relative deposition rate
dBa	A-weighted decibels
DCE	cis-1,2 dichloroethylene
DCP	Dry Conversion Process
DFP	Decommissioning Funding Plan
DMR	Discharge Monitoring Report
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOT	U.S. Department of Transportation
ECC	Emergency Control Center
EHS	Environment, Health, and Safety
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
EPR	Evolutionary Pressurized Water Reactor

ERI	Energy Resources International, Inc.
ESA	Endangered Species Act
ESBWR	Economic Simplified Boiling Water Reactor
ETC	Enrichment Technology Corporation
FCO	Fuel Components Operations
FEMA	Federal Emergency Management Agency
FGHC	Favorable Geometry Hybrid Containers
FIES	Final Environmental Impact Statement
FINDS	Facility Index System/Facility Registry System
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMO	Fuel Manufacturing Operation
FMOX	Fuel Manufacturing Operation Expansion
FPPA	Farmland Protection Policy Act
fps	feet per second
ft	foot
ft^2	square foot
ft^3/s	cubic feet per second
FTE	full-time equivalent employees
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
GE	General Electric Company
GEH	GE-Hitachi Nuclear Energy
GENE	GE Nuclear Energy
GIS	geographic information systems
GLE	GE-Hitachi Global Laser Enrichment LLC
GMT	Greenwich Mean Time
GNEP	Global Nuclear Energy Partnership
GNF-A	Global Nuclear Fuel–Americas
gpd	gallons per day
GPS	global positioning system
GWe	Gigawatt electrical
GWLF	Generalized Watershed Loading Function
ha	hectare
HAP	hazardous air pollutant
HEPA	high-efficiency particulate air
HEU	highly enriched uranium
HF	hydrogen fluoride

Hz	hertz
I-140	U.S. Interstate Highway 140
I-20	U.S. Interstate Highway 20
I-40	U.S. Interstate Highway 40
I-74	U.S. Interstate Highway 74
I-95	U.S. Interstate Highway 95
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IDLH	immediately dangerous to life and health
IEA	International Energy Association
IHS	Industrial Health and Safety
IMD	Incident Management Database
IPCC	Intergovernmental Panel on Climate Change
IROFS	Items Relied On For Safety
ISA	integrated safety analysis
ITE	Institute of Transportation Engineers
kg	kilogram
km	kilometer
kts	knots
kVa	kilovolt-amperes
LCFRP	Lower Cape Fear River Program
L_{DN}	day-night average sound levels
LEPC	New Hanover County Local Emergency Planning Committee
L_{EQ}	energy equivalent sound levels
LES	Louisiana Energy Services, L.P.
LEU	low-enriched uranium
LIDAR	Light Detection and Ranging
LL	liquid limits
LLRW	low-level radioactive waste
LLW	low-level waste
LOMC	letters of map change
LORAN	Long-Range Aids to Navigation
LOS	Level of Service
lpd	liters per day
m	meter
m/s	meters per second
m/s/s	meters per second per second
m^2	square meter

m^3/s	cubic meters per second
MCDA	Multi-Criteria Decision Analysis
MDC	minimum detectable concentration
MEI	maximum exposed individual
Mg	megagram
mGy/d	milliGray/day
MLIS	Molecular Laser Isotope Separation Process
mm	millimeter
MOTSU	Military Ocean Terminal Sunny Point
mph	miles per hour
MRDS	Minerals Resource Data System
mrem	millirem
MSA	Metropolitan Statistical Area
MSD	musculoskeletal disorder
msl	above mean sea level
mSv	milliSieverts
MSW	municipal solid waste
mt	metric ton
mT	maritime tropical
MWe	Megawatt electrical
NA	not applicable
NAAQS	National Ambient Air Quality Standard
NAVD	North American Vertical Datum
NC 130	N.C. Route 130
NC 132	N.C. Route 132
NC 133	N.C. Highway 133
NC 179	N.C. Route 179
NC 210	N.C. Highway 210
NC 211	N.C. Route 211
NC 53	N.C. Route 53
NC 87	N.C. Route 87
NC CRC	North Carolina Coastal Resources Commission
NC DAQ	North Carolina Division of Air Quality
NC DCM	North Carolina Division of Coastal Management
NC DEH	North Carolina Division of Environmental Health
NC DFR	North Carolina Division of Forest Resources
NC DHHS	North Carolina Department of Health and Human Services
NC DOT	North Carolina Department of Transportation

NC DWM	North Carolina Division of Waste Management
NC DWQ	North Carolina Division of Water Quality
NC DWR	North Carolina Division of Water Resources
NC EMC	North Carolina Environmental Management Commission
NC OSA	North Carolina Office of State Archaeology
NC SHPO	North Carolina State Historic Preservation Office
NC SPA	North Carolina State Ports Authority
NCDA	North Carolina Department of Agriculture
NCDENR	North Carolina Department of Environment and Natural Resources
NCEEP	North Carolina Ecosystem Enhancement Program
NC-ESC	North Carolina Employment Security Commission
NCGS	North Carolina Geological Survey
NCI	National Cancer Institute
NCMFC	North Carolina Marine Fisheries Commission
NCNHP	North Carolina Natural Heritage Program
NCRFPAR	North Carolina Regulations for Protection Against Radiation
NCRP	North Carolina Division of Radiation Protection
ND	not detected
NEF	National Enrichment Facility
NEHRP	National Earthquake Hazard Reduction Program
NELAC	National Environmental Laboratory Accreditation Conference
NELAP	National Environmental Laboratory Accreditation Program
NEPA	National Environmental Policy Act
NERR	national estuarine research reserve
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHEO	Natural Heritage Element Occurrences
NHPA	National Historic Preservation Act
NIOSH	National Institute for Safety and Health
NIST	National Institute of Standards and Technology
NL	not listed
NLCD	National Land Cover Database
NMSS	Nuclear Material Safety and Safeguards
No	number
NO_x	nitrogen oxides
NO_2	nitrogen dioxide
NPDES	National Pollutant Discharge Elimination System
NPL	CLERCA Superfund National Priority List
NPS	National Park Service

NRC	U.S. Nuclear Regulatory Commission
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
O_3	ozone
OMB	Office of Management and Budget
ORW	Outstanding Resource Water
OSD	NRCS Soil Survey Division Official Soil Series Descriptions
OSH Act	Occupational Safety and Health Act
OSHA	Occupational Safety and Health Administration
Pb	lead
pCi	picocuries
PE	probability of exceedance
PEL	permissible exposure limit
PGA	percent g
PIES	Programmatic Environmental Impact Statement
PI	plasticity indices
PM	particulate matter
$PM_{2.5}$	particulate matter with aerodynamic diameter of 2.5 μm or less
PM_{10}	particulate matter with aerodynamic diameter of 10 μm or less
PNA	primary nursery areas
PPE	personal protection equipment
ppm	parts per million
PQL	practical quantitation limit
PWR	Partially Weathered Rock
PWSS	Public Water Supply Section
QA	quality assurance
QC	quality control
rad	radiation absorbed dose
RCRA	Resource Conservation and Recovery Act
REL	recommended exposure limit.
ReNuMa	Regional Nutrient Management
RPS	Radiation Protection Section
RSA	Radiation Safety Analyses
RUSLE	Revised Universal Soil Loss Equation
RWP	Radiation Work Permit
SA	Supplement Analysis
SARA	Superfund Amendments and Reauthorization Act

scfph	standard cubic feet per hour
SCO	Services Components Operation
SDO	stormwater discharge outlet
SDWA	Safe Drinking Water Act
SILEX	Separation of Isotopes by Laser Excitation
sL/m	standard liters per minute
SNHA	Significant Natural Heritage Area
SNM	Special Nuclear Material
SOP	standard operating procedure
SO_2	sulfur dioxide
SPB	Survey and Planning Branch
SPCC	Spill Prevention Control and Countermeasure
SPPP	Stormwater Pollution Prevention Plan
STAR	EPA Stability Array program
STEL	short term exposure limit.
STORET	STOrage and RETrieval data repository
sV	sieVert
SWU	Separative Work Units
TAP	toxic air pollutants
TCE	trichloroethylene
TEDE	total effective dose equivalent
TEU	Twenty-foot Equivalent Unit
TLD	thermoluminescent dosimeters
TRAGIS	Transportation Routing Analysis Geographic Information System
TSDF	treatment, storage, and disposal facility
TSP	total suspended particulates
TSS	total suspended solids
TWA	time-weighted average
U_3O_8	triuranium octaoxide
UDS	Uranium Disposition Services, LLC
UF_4	uranium tetrafluoride
UF_6	uranium hexafluoride
UO_2	uranium dioxide
UO_2F_2	uranyl fluoride
US 117	U.S. Highway 117
US 17	U.S. Route 17
US 421	U.S. Route 421
US 74-76	U.S. Route 74-76

US 76	U.S. Route 76
USACE	U.S. Army Corps of Engineer
USAPWR	U.S. Advanced Pressurized Water Reactor
USCS	Unified Soil Classification System
USDA	U.S. Department of Agriculture
USEC	United States Enrichment Corporation
USFS	United States Forest Service
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
UST	NCDENR underground storage tank database
VBA	Visual Basic for Applications
VC	vinyl chloride
VOC	volatile organic compound
VRMS	Visual Resources Management System
WCS	Waste Control Specialists, LLC
WMPO	Wilmington Metropolitan Planning Organization
WNA	World Nuclear Association
yr	year
χ/Q	normalized concentration

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ES-1 Wilmington Site location and vicinity.

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Executive Summary

GE-Hitachi Global Laser Enrichment LLC (GLE) is the applicant for a license from the U.S. Nuclear Regulatory Commission (NRC) to construct and operate a uranium-enrichment facility (henceforth referred to as the Proposed GLE Facility or the Facility). The license would authorize GLE to possess and use special nuclear, source, and by-product material in the Facility. The National Environmental Policy Act (NEPA) of 1969 requires federal agencies, as part of their decision making process, to consider the environmental impacts of actions under their jurisdiction. The NRC has established regulations to implement the NEPA requirements in 10 Code of Federal Regulations (CFR) 51 (*Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions*). This Environmental Report (Report) is being submitted to the NRC by GLE to comply with the 10 CFR 51 requirements in support of the licensing of the Proposed GLE Facility. The Report is organized according to the guidance for applicants provided by NRC in NUREG-1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS (Nuclear Material Safety and Safeguards) Programs*, dated August 2003.

Proposed Action

The Proposed Action is to construct and operate a facility that would use a laser-based technology to separate or enrich the naturally occurring isotopes of uranium. GLE proposes to locate the Proposed GLE Facility on the existing General Electric Company (GE)/Global Nuclear Fuel–Americas (GNF-A) property near Wilmington, NC (henceforth referred to as the Wilmington Site), in accordance with the Atomic Energy Act of 1954, as amended; 10 CFR 40 (*Domestic Licensing of Source Material*); 10 CFR 70 (*Domestic Licensing of Special Nuclear Material*); and other applicable laws and regulations. It is GLE's intent that at the end of the Facility's operating life, the planned decommissioning activities would achieve release of the Proposed GLE Facility site for NRC license termination and unrestricted land use pursuant to 10 CFR 20.1401 (*General provisions and scope [Standards for Protection Against Radiation]*) and 10 CFR 20.1402 (*Radiological criteria for unrestricted use [Standards for Protection Against Radiation]*).

The Wilmington Site is situated on a 1,621-acre (656-hectare [ha]) tract of land located in an unincorporated area in northwest New Hanover County. **Figure ES-1** shows the location of the Site in relation to nearby cities, towns, landmarks, highways, and rivers and other waterbodies. The Wilmington Site is approximately 6 miles (9.6 kilometers [km]) north of the city of Wilmington. Industrial land uses are dominant on the opposite (west) side of the Northeast Cape Fear River across from the Site. In the eastern and southern vicinities of the Wilmington Site, residential land uses are dominant. The area north and northwest of the Site is a large, privately owned tract of land currently used for timber management and as a private hunting area. The eastern boundary of the Wilmington Site borders on N.C. Highway 133 (NC 133, also known as Castle Hayne Road and, previously, U.S. Highway 117) near its intersection with U.S. Interstate Highway 140 (I-140). Wilmington International Airport is located approximately 3.5 miles (5.2 km) southeast of the Site.

The Wilmington Site is zoned I-2 for Heavy Industrial land use. The eastern sector of the Wilmington Site is developed and is the location of the two principal on-site industrial operations: the GNF-A Fuel Manufacturing Operation (FMO) facility and the GE Aircraft Engines and Services Components Operation facility. Other on-site facilities in this sector support the manufacture of auxiliary equipment for nuclear reactors, the fabrication of zirconium components for fuel assemblies, and other supporting Site operations, engineering, and administration functions. The western sector of Wilmington Site is predominantly undeveloped, forested land.

Implementation of the Proposed Action would allow GLE to construct and operate a facility with the capability to enrich uranium up to 8% by weight of uranium-235 (^{235}U), with an initial planned maximum target annual production capacity of 6 million Separative Work Units (SWU). The Proposed GLE Facility would use a new uranium-enrichment process that is being developed by GLE in exclusive agreement with Silex Systems Limited. Feed material for the process would be uranium hexafluoride (UF_6), which is transported to the Proposed GLE Facility by truck. The process separates ^{235}U (the fissile isotope) from uranium-238 (^{238}U) in the UF_6 feed material and produces a UF_6 product stream enriched in ^{235}U and a waste stream depleted in ^{235}U (referred to as "UF_6 tails").

The Proposed GLE Facility would occupy approximately 100 acres (40 ha) in the North-Central Site Sector of the Wilmington Site. Within this area would be an approximately 600,000-square-foot (56,000-square-meter) main GLE operations building in which the uranium-enrichment process would be conducted. Other facilities would include several administrative and other Facility-support buildings, a parking lot, outdoor UF_6 cylinder storage pads, and maintained landscaped areas. Within the GLE Study Area, but outside and to the east of the 100-acre (40-ha) Proposed GLE Facility, would be an electrical substation, wastewater lift stations, access roads, guard houses, a water tower, and a stormwater wet detention basin.

Water for the Proposed GLE Facility would be provided by the existing well system at the Wilmington Site. Aboveground electric utility lines would connect the Proposed GLE Facility to the new electrical substation, which would be located on-site near the existing high-voltage electrical power transmission lines that already transect the Site through a utility corridor easement. Access to the Proposed GLE Facility from NC 133 (Castle Hayne Road) would be provided by a road located entirely on the Wilmington Site property near the Site's northeastern boundary (referred to as the proposed North access road). For direct transport (i.e., avoiding public roads) between the Proposed GLE Facility and GNF-A's FMO, an existing on-site service road would be paved and the existing stream crossing along this road would be improved (the improved road is referred to as the proposed South access road). The Proposed Action includes placement of new utility lines within existing utility corridors and/or clearings to the fullest extent practicable to minimize the need for additional wetlands crossings and for the clearing of additional wooded areas at the Site. The Proposed GLE Facility would not require the construction of new roads or new electrical, water, and sewer lines outside of the Wilmington Site boundaries.

The Proposed GLE Facility would use a combination of environmental control systems, treatment processes, monitoring programs, and work practices to protect worker and public health and the environment. Any gaseous releases from areas inside the main operations building in which UF_6 is handled and processed would be captured and routed through a multi-stage air emission control system. Similarly, liquid radiological wastewater would be collected in a closed, dedicated drain system connected to a GLE liquid effluent treatment system. Sanitary wastewater, cooling tower process wastewater, and treated radwaste would be routed from the Proposed GLE Facility to the Wilmington Site's existing permitted wastewater treatment facilities using pumping lift stations constructed adjacent to and east of the 100-acre (40-ha) Proposed GLE Facility. Solid wastes would be managed at the Proposed GLE Facility according to applicable regulations and good management practices and would be shipped off-site for recycling, recovery, or disposal to a licensed facility as appropriate for the waste type. No solid wastes would be land disposed at the Wilmington Site.

The enriched UF_6 produced at the Proposed GLE Facility would be used on-site by GNF-A in its FMO facility and shipped by truck to off-site customers. The UF_6 tails generated by the Proposed GLE Facility operations would be trucked to one of the U.S. Department of Energy's depleted uranium conversion facilities at the Paducah, KY, and Portsmouth, OH, sites or to a commercial depleted UF_6 conversion facility, should one become available. Until these facilities are operational and accept the UF_6 tails for processing, the UF_6 tails would be stored on-site at the Proposed GLE Facility. Low-level radioactive

waste (LLRW) generated by Proposed GLE Facility operations and requiring off-site disposal would be shipped solely by truck to the Energy*Solutions* facility in Clive, UT, or another licensed LLRW disposal facility, should one become available.

Need for Proposed Action

Actual and projected increases in U.S. nuclear power generating capacity indicate an increasing national demand for uranium-enrichment services, given that enrichment is an integral step in the nuclear fuel cycle. Based on current trends, existing U.S. sources alone will not be able to provide a dependable and economical domestic supply to meet the growing U.S. demand for these enrichment services. New domestic sources of enriched uranium are needed to replace the aging, energy-intensive Paducah Gaseous Diffusion Plant, which will need to be retired in the near future. The joint U.S. and Russian governments' "Megatons to Megawatts" Program, in which highly-enriched uranium from dismantled Russian nuclear warheads is being blended-down into low-enriched uranium to produce fuel for U.S. nuclear power plants, is scheduled to end in 2013. These two sources meet approximately half of the current U.S. demand for low-level enriched uranium. The Proposed Action is intended to satisfy the need for additional reliable and economical domestic sources of enriched uranium supply, particularly as existing aging and less-efficient production facilities cease operation. By supplying enrichment services to commercial nuclear fuel manufacturing plants, the Proposed GLE Facility would support the continued operation of existing nuclear power plants and the future operation of proposed new plants. In addition, the Proposed Action is intended to satisfy the need for domestic uranium-enrichment capacity for national energy security and the need to further establish advanced uranium-enrichment technology in the United States.

Consideration of Alternatives to the Proposed Action

The enrichment technology alternatives to using a laser-based technology are to continue using either the gaseous-diffusion or gas centrifuge uranium-enrichment technologies. Both technologies rely on the small difference in mass between ^{235}U and ^{238}U to separate the isotopes using mechanical methods. At present, gaseous-diffusion technology is the only technology in commercial use in the United States; however, due to its relatively large resource requirements, the gas centrifuge technology to be used at the proposed National Enrichment Facility in Eunice, NM, and the American Centrifuge Plant in Piketon, OH, is known to be more efficient and less energy-intensive than the gaseous-diffusion technology.

The laser-based enrichment technology to be used for the Proposed GLE Facility is anticipated to offer distinct advantages over both gaseous-diffusion and centrifuge-enrichment processes. The laser-based enrichment technology is more efficient than either of the mechanical process-based technologies previously discussed. Not only does this higher efficiency lower capital and operating costs of the enrichment operation, but it also allows for more flexibility in product-enrichment levels (the percentage of ^{235}U in the final product) at a given site. The technological advantages of the laser-based enrichment technology also are anticipated to result in reduced environmental impacts compared to gaseous-diffusion and centrifuge enrichment processes due to the smaller facility footprint for the same SWU capacity, lower cooling water requirements, no chlorofluorocarbon use, and lower energy requirements. To achieve these operational and environmental impact advantages, the laser-based enrichment technology was chosen for the Proposed GLE Facility.

Section 102(2)(c) of the NEPA requires that siting alternatives for a proposed action be evaluated. A site-selection process was performed to evaluate a proposed site and the alternative sites to identify the preferred site for the construction and operation of the Proposed GLE Facility. The preferred site was determined by a multi-step process that included the following steps:

- *Identification of 22 candidate sites* for locating the Proposed GLE Facility.
- *Initial screening* of the candidate sites to eliminate from further consideration those sites identified to be located in hazard zones created by seismicity, recent faulting, or flooding that could potentially jeopardize safe operation of the Proposed GLE Facility.
- *Coarse screening* of remaining sites that pass the initial screening using business-decision related criteria.
- *Site-reconnaissance visits* to those remaining sites for which the final determination of the coarse-screening criteria could only be verified by an on-site visit and discussions with site employees and management.
- *Fine screening* of the sites remaining after the previous screening steps using a set of detailed site-level evaluation criteria based on public health and safety factors, as well as potential environmental and socioeconomic impacts.
- *Qualitative cost-benefit analysis (CBA)* comparing the net benefits of locating the Proposed GLE Facility at each of the sites evaluated for the fine screening.

The results of the site-selection process concluded that the Wilmington Site is the preferred site for the Proposed GLE Facility.

Following selection of the Wilmington Site for the Proposed Action, areas within the Site's property boundaries were evaluated to locate the Proposed GLE Facility. Undeveloped locations within the Wilmington Site were considered, but were eliminated from further evaluation due to a variety of factors, including insufficient acreage available for the Proposed GLE Facility or their proximity to floodplains, streams, and/or readily apparent wetlands or rare ecological resources that would likely require a significant degree of mitigation.

Environmental Impacts of Proposed Action

Environmental resource impacts were evaluated for the Proposed Action and the No Action Alternative. Under the No Action Alternative, the Proposed Action would not take place; the No Action Alternative establishes the baseline for assessing the environmental impacts of the Proposed Action. Environmental impacts from an action that are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of an applicable environmental resource are assigned the significance level of SMALL. When the environmental impacts from an action are sufficient to alter noticeably, but not to destabilize, important attributes of a resource, a significance level of MODERATE is assigned. Environmental impacts that are clearly noticeable and are sufficient to destabilize important attributes of a resource are assigned the significance level of LARGE.

The environmental impacts for the No Action Alternative would be SMALL. A uranium-enrichment facility would not be added to the Wilmington Site. The existing industrial facilities at the Wilmington Site would continue to operate.

The types and magnitudes of the environments impacts for the Proposed Action would vary during the Proposed GLE Facility construction, operation, and decommissioning phases. In general, the unavoidable residual adverse impacts for the Proposed Action after implementation of mitigation measures to control and minimize potential adverse impacts would be SMALL, with the exception of MODERATE impacts for transportation, ecological, depleted UF_6 waste management, and noise resources on a localized or temporary basis (i.e., at or in the immediate vicinity of the Proposed GLE Facility or only during the construction phase). On a regional basis, the impacts for these resources also would be SMALL. No LARGE adverse environmental impacts are identified for the Proposed GLE Facility.

The Proposed GLE Facility would be constructed on land already owned by GE and currently not accessible by the public. No identified cultural or historical resources would be impacted by the Proposed Action. The Proposed GLE Facility would create no visual/resource impacts that are out of character with the Wilmington Site vicinity or alter its existing mixed land-use setting. Potential impacts from geological conditions on the Proposed GLE Facility are expected to be SMALL and mitigated through engineering controls.

The Proposed Action would result in SMALL direct impacts on stream channels by creating a crossing for the proposed North access road and modifying an existing crossing to be used for the proposed South access road. Water-quality impacts from construction and operation of the Proposed Action would be SMALL due to the use of best management practices (BMPs) and standard waste treatment operations. The Proposed Action does not use surface water as a source of water. Any impacts from the Proposed Action on groundwater quality are anticipated to be SMALL. Groundwater levels are not anticipated to change significantly in response to changes in pumping required for the Proposed Action; therefore, water consumption by the Proposed GLE Facility would not notably impact the supply of water to other users in the area. Upgrade of the existing stream crossing for the South access road would occur within the floodplain boundary, but no other topographic impacts to floodplains are anticipated. Minor changes in floodwater volume and flow during extreme storm events are anticipated, and these SMALL impacts would be mitigated by natural systems. The Main 100-acre (40-ha) area of the Proposed GLE Facility would not directly impact any wetlands. The proposed North access road would cross two jurisdictional wetland areas and potentially impact two isolated wetlands. The existing gravel service road that would be upgraded to serve as the proposed South access road crosses and abuts another jurisdictional wetland; however, this wetland would not be directly impacted from the modifications to the existing roadway. Direct and indirect impacts to these wetlands would be SMALL and mitigated to the extent practicable and as required by regulations.

Construction and operation of the Proposed GLE Facility and proposed North and South access roads would displace some local wildlife populations to nearby habitat in the western portion of the Wilmington Site and disrupt wildlife travel corridors. Human encounters with some wildlife could increase due to disruption of travel corridors and loss of habitat. No direct impacts to rare or unique habitats or commercially or recreationally valuable species would result from the Proposed Action. The removal of forested biotic communities would noticeably alter the composition of habitat, but would not destabilize the existence of these communities. Overall, wildlife populations on the Wilmington Site would be altered, but the existence of these species would not be destabilized. Therefore, direct and indirect impacts to ecological resources from the Proposed Action would be MODERATE.

Workers at the Proposed GLE Facility would use appropriate safety equipment and procedures to limit to acceptable levels any radiation and chemical exposure that would occur during material handling and maintenance activities required for operation of the uranium-enrichment process. During construction, operation, and decommissioning of the Proposed GLE Facility, air emissions control systems, monitoring programs, and BMPs would be used to limit the amounts of air pollutants released to the atmosphere so as to not significantly affect the ambient air concentration levels to which the public is exposed. Wastewaters generated by the Proposed GLE Facility operations would be treated on-site to meet National Pollutant Discharge Elimination System (NPDES)–permit requirements before being discharged to receiving waterbodies used by the public. Solid wastes would be managed on-site in accordance with good waste storage and handling practices and shipped for recycling, re-use, or final treatment or disposal at licensed facilities appropriate for the waste type.

Overall population, economic, and social adverse impacts from the Proposed GLE Facility are anticipated to be SMALL. The numbers of workers required for construction, operation, and decommissioning of the Proposed GLE Facility are expected not to significantly affect housing, educational, medical, law

enforcement, and fire services in the region. The Proposed Action is not expected to result in disproportionately adverse impacts on low-income or minority residents.

Motor vehicle traffic generated by the construction and operation of the Proposed GLE Facility could increase local traffic congestion during certain times of the day on roadways in the vicinity of the NC 133 (Castle Hayne Road)/I-140 interchange, creating MODERATE impacts; however, overall transportation impacts would be SMALL on a regional basis. Existing residents living adjacent to the northeastern Wilmington Site property boundary near the proposed North access road could be exposed to temporary MODERATE noise impacts for short durations during initial preparation of the GLE Facility site and construction activities for the Proposed GLE Facility. Because most noise-generating sources associated with operation of the Proposed GLE Facility would be located inside structures, noise impacts for the remainder of the operating life of the Proposed GLE Facility would be SMALL.

Cost-Benefits of the Proposed Action

A CBA was performed to assess the overall impact of the Proposed Action on society's well-being, including benefits and costs accruing to GLE, as well as benefits and costs experienced by other members of society. The anticipated benefits of the Proposed GLE Facility include socioeconomic benefits and environmental benefits. Profits earned by GLE from Facility operations and additional jobs and spending in the regional economy may be regarded as external financial benefits. Similarly, the additional tax revenues that may be received by federal, State, and local government as a result of the Proposed Action may also be regarded as a socioeconomic benefit. Environmental benefits of the Proposed Action include increased energy security due to increased quantity and reliability of supply for enriched uranium, possible increases in the share of electric power that is generated by nuclear plants, and the use of a less energy-intensive enrichment technology. In addition, the Proposed GLE Facility would provide enriched uranium to fuel existing and potential new U.S. nuclear power plants. Nuclear power plants provide a critical source of base-load electricity without emitting the air pollutants and greenhouse gasses associated with coal-fired power plants and other combustion-based power generation sources.

The estimated environmental and socioeconomic costs and impacts of the Proposed Action are generally SMALL, and many of the anticipated external impacts may be offset by mitigation measures. These impacts include increases in traffic associated with the Wilmington Site, small increases in releases to surface water, small increases in air emissions, and possible impacts, but not adverse impacts, on some Federal Species of Concern.

Conclusion

The Proposed Action is to construct and operate a facility at the Wilmington Site that would use a laser-based technology to enrich uranium for use by nuclear fuel manufacturing facilities. The licensing of the Proposed GLE Facility is an important step toward advancing the national energy security goals of maintaining a reliable and economical domestic source of enriched uranium. Short-term impacts of the Proposed GLE Facility on the public and the environment would be controlled and minimized to the extent practical with the implementation of mitigation measures and good resource management practices. Considering both private and external benefits and costs, the Proposed GLE Facility would increase society's welfare by producing positive net benefits. The construction, operation, and decommissioning of the Proposed GLE Facility at the Wilmington Site would require short-term uses of environmental resources that would have an overall SMALL adverse impact on the environment and the quality of life for the public.

Figure

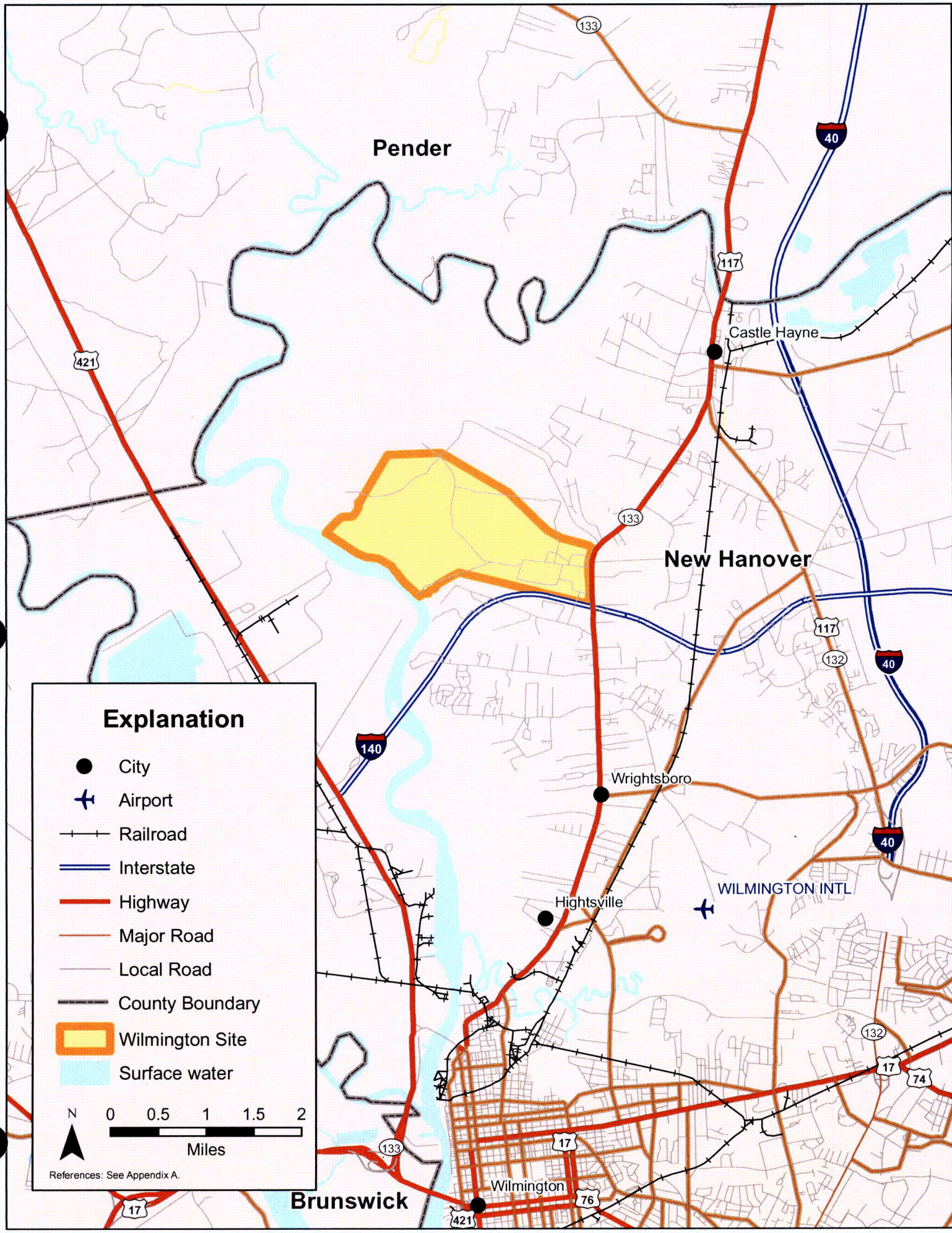

Figure ES-1. Wilmington Site location and vicinity.

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1. Introduction

GE-Hitachi Global Laser Enrichment LLC (GLE) is the applicant for a license to construct and operate a uranium-enrichment facility (henceforth referred to as the Proposed GLE Facility or the Facility). This license would authorize GLE to possess and use special nuclear, source, and by-product material in the Facility. As required by 10 Code of Federal Regulations (CFR) 51 (*Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions*), this Environmental Report (Report) is being submitted to the U.S. Nuclear Regulatory Commission (NRC) by GLE to support licensing of the Proposed GLE Facility. The Proposed GLE Facility is an important step toward advancing the national energy security goals of maintaining a reliable and economical domestic source of enriched uranium. As the Proposed Action, GLE proposes to locate the Proposed GLE Facility on the existing General Electric Company (GE)/Global Nuclear Fuel–Americas (GNF-A) property near Wilmington, NC (henceforth referred to as the Wilmington Site), in accordance with the Atomic Energy Act of 1954, as amended; 10 CFR 40 (*Domestic Licensing of Source Material*); 10 CFR 70 (*Domestic Licensing of Special Nuclear Material*); and other applicable laws and regulations.

This Environmental Report is organized in accordance with the guidance contained in NUREG-1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS (Nuclear Material Safety and Safeguards) Programs*, dated August 2003. This chapter provides an introduction and background on the history of the Wilmington Site and discusses why GLE is requesting an NRC license to construct and operate a uranium-enrichment facility. **Chapter 2** of this Report (*Alternatives*) discusses the Proposed Action and alternatives, including the No Action Alternative and siting alternatives. **Chapter 3** (*Description of Affected Environment*) discusses the existing environmental conditions at the Wilmington Site, and **Chapter 4** (*Environmental Impacts*) discusses how those conditions would be affected, if at all, by the Proposed Action. **Chapter 5** (*Mitigation Measures*) discusses proposed mitigation measures that may be implemented by GLE to mitigate potential environmental impacts of the Proposed Action. **Chapter 6** (*Environmental Measurement and Monitoring Programs*) discusses the environmental measurement and monitoring programs established for the Proposed GLE Facility. **Chapter 7** (*Cost-Benefit Analysis*) discusses the cost-benefit analysis for the Proposed GLE Facility. **Chapter 8** (*Summary of Environmental Consequences*) summarizes the potential environmental consequences of the Proposed Action. **Chapter 9** (*List of References*) and **Chapter 10** (*List of Preparers*) present the references for and preparers of this Environmental Report. **Chapter 11** (*Glossary*) contains a glossary of terms used in this Report.

1.1 Background

The existing Wilmington Site, the site selected for the Proposed GLE Facility, is situated on a 1621-acre (656-hectare [ha]) tract of land, located west of N.C. Highway 133 (NC 133, also known as Castle Hayne Road and, previously, U.S. Highway 117). The Wilmington Site spans between latitudes (North) 34° 19' 4.0''and 34° 20' 28.9'' and between longitudes (West) 77° 58' 16.4'' and 77° 55' 19.8'' and is located approximately 6 miles (9.6 kilometers [km]) north of the city of Wilmington in New Hanover County, NC (**Figures 1-1 and 1-2**).

The Wilmington Site is bordered on the east by NC 133 (Castle Hayne Road), which includes some commercially and residentially developed adjacent properties; on the southwesterly perimeter by the Northeast Cape Fear River; and for most of the north and south property lines, by undeveloped forestlands. A small (approximately 1,000-foot [ft; 305-meter [m]]) segment of the north property line borders the Wooden Shoe residential subdivision. The south property line for about 3,000 ft (914 m) is bordered by U.S. Interstate Highway 140 (I-140), and directly south of the bypass are residentially developed properties.

For better orientation and reference to feature locations for this Report, the Wilmington Site was divided into the following five sectors (**Figure 1-2**):

- **Eastern Site Sector.** This sector covers the eastern portion of the Wilmington Site and contains the existing Wilmington Site facilities.
- **North-Central Site Sector.** This sector covers the north-central portion of the Wilmington Site.
- **Northwestern Site Sector.** This sector covers the northwestern corner of the Wilmington Site.
- **South-Central Site Sector.** This sector covers the south-central portion of the Wilmington Site.
- **Western Site Sector.** This sector covers the western portion of the Wilmington Site and includes 182 acres (74 ha) classified as Swamp Forest, located on the floodplain of the Northeast Cape Fear River.

An additional 24-acres (10-ha) east of NC 133 (Castle Hayne Road) also are owned by GE. This land is undeveloped except for GE potable water wells, an employee park, and a leased portion of the property that is used as a transportation terminal.

The existing Wilmington Site operations include two principal manufacturing operations: the GNF-A Fuel Manufacturing Operation (FMO) facility and the GE Aircraft Engines/Services Components Operation (AE/SCO) facility (see **Figure 1-2**). There are approximately 1,282,000 square feet (ft^2; 119,000 square meters [m^2]) of constructed facilities in the Eastern Site Sector supporting GNF-A, including the FMO/Fuel Manufacturing Operation Expansion (FMOX) and the Dry-Conversion Process (DCP) facility with its associated hydrofluoric acid recovery facility. Additional GNF-A operations are typical of conventional metal-working plants and are performed in facilities separate from the FMO facility. These other facilities support the manufacture of auxiliary equipment for nuclear reactors, the fabrication of zirconium components for fuel assemblies (Fuel Components Operation [FCO], see **Figure 1-2**), and other supporting engineering and administration functions. Machining of AE rotating parts takes place in the GE AE/SCO facility.

The history of the Wilmington Site is summarized below:

- 1966 – Selection of Wilmington location
- 1967 – Start up of site preparation
- 1968 – Initiation of first machining operations — zircaloy and stainless steel
- 1969 – Issuance of Special Nuclear Material (SNM) License Number (No.) 1097
- 1973 – Expansion of fuel manufacturing building
- 1976 – Renewal of SNM License No. 1097
- 1981 – Initiation of AE components manufacturing
- 1984 – Renewal of SNM License No. 1097
- 1985 – Additional capability operational for uranium recovery from wastes
- 1989 – Renewal of SNM License No. 1097
- 1994 – Nuclear Fuel Engineering on-site
- 1997 – Renewal of SNM License No. 1097
- 1997 – DCP starts up in place of ammonium diuranate (ADU) process
- 1998 – Reduction/elimination of liquid waste streams

- 2000 – GE joint venture with Hitachi and Toshiba (GNF-A)
- 2003 – GE Nuclear Energy (GENE) Headquarters moves to Wilmington Site
- 2005 – Vineland, NJ, nuclear parts distribution center moves to Wilmington Site
- 2007 – Application for amendment of SNM License to authorize SILEX (Separation of Isotopes by Laser Excitation) test-loop facility
- 2007 – Renewal application for SNM License 1097 submitted to NRC
- 2007 – Hitachi acquires partnership in GLE
- 2008 – Cameco acquires partnership in GLE.

New Hanover County is located in southeastern North Carolina in the Mid-Atlantic Coastal Plain physiographic province (see **Section 3.3.1** of this Report, *Regional Geology*) between the Atlantic Ocean on the east, the Cape Fear River on the west, and Pender County on the north. Due to the curvature of the coastline in this area, the ocean lies approximately 10 miles (16.1 km) east and 26 miles (42 km) south of the Wilmington Site (see **Figure 1-1**). The surrounding terrain is typical of coastal North Carolina, with an elevation that averages less than 40 ft (12.2 m) above mean sea level (msl), and is characterized by level to gently rolling terrain consisting of forest, rivers, creeks, and swamps or marsh lands.

The Wilmington Site is located in an unincorporated area in northwest New Hanover County. Industrial land uses are dominant on the opposite (west) side of the Northeast Cape Fear River across from the Site. In the eastern and southern vicinities of the Wilmington Site, residential uses are dominant, with the presence of the unincorporated communities of Wrightsboro (south), Skippers Corner (east), and Castle Hayne (northeast). The area north and northwest of the Site is a large, privately owned tract of land that is currently used for timber management and as a private hunting area. The southeastern corner of the Wilmington Site borders on an interchange of I-140. The Wilmington International Airport is located approximately 3.5 miles (5.2 km) southeast of the Site.

1.1.1 The GLE Study Area

The GLE Study Area consists of 265 acres (107 ha) of the Wilmington Site and is divided into three portions, which are described below and illustrated on **Figure 1-3**. **Figure 1-4** is a topographic map of the Wilmington Site showing the GLE Study Area. The three portions of the GLE Study Area are as follows:

- **Main portion of the GLE Study Area.** A 209-acre (85-ha) area within the North-Central Site Sector evaluated for the placement of the Proposed GLE Facility and areas around the Facility for potential future expansion.
- **North Road portion of the GLE Study Area.** A 200-ft (61-m) wide corridor consisting of 33 acres (13 ha) within the Eastern Site Sector, extending from the Main portion of the GLE Study Area. This portion of the GLE Study Area includes an existing gravel road, which would be widened, and proposed new road segments that would connect the Proposed GLE Facility to NC 133 (Castle Hayne Road).
- **South Road portion of the GLE Study Area.** A 200-ft (61-m) wide corridor consisting of 23 acres (9.3 ha) within the North-Central, South-Central, and Eastern site sectors that includes an existing gravel road from the Main portion of the GLE Study Area to the existing Wilmington Site facilities.

The Proposed GLE Facility would be situated in the Main portion of the GLE Study Area. The Facility is planned to initially occupy approximately 100 acres (40 ha) of the 209 acres (85 ha) of the Main portion of the GLE Study Area (**Figure 1-3**).

1.1.2 Proposed GLE Facility

On May 22, 2006, GNF-A announced that it had signed an exclusive agreement with Australia's Silex Systems Limited to license the technology and develop the company's next-generation, low-enriched uranium (LEU) manufacturing process in the United States. The SILEX laser-based technology uses lasers to separate or enrich the naturally occurring isotopes of uranium. The agreement provides for a phased approach to implementation of the SILEX laser-based enrichment technology, including the construction of test-loop and full-scale commercial enrichment facilities (NRC, 2007). GE-Hitachi Nuclear Energy (GEH) modified the SILEX technology for the test loop and for the GLE commercial facility; this technology is hereafter referred to as the GLE laser-based technology.

In June 2007, GNF-A filed an application with the NRC to amend its Special Nuclear Material license to authorize operation of a semi-scale test loop and other experimental equipment for laser-enrichment process research and pre-production testing within the existing GNF-A FMO facility at the Wilmington Site. The test loop is intended to verify performance and reliability data for the full-scale (commercial) Proposed GLE Facility. The NRC approved the license amendment in May 2008. This Report is part of the license application by GLE for a full-scale commercial enrichment facility using the GLE laser-based technology.

At present, gaseous-diffusion technology is the only enrichment technology in commercial use in the United States; however, it has relatively large resource requirements. The gas centrifuge technology to be used at the Louisiana Energy Services, L.P. (LES)–proposed National Enrichment Facility (NEF) and the United States Enrichment Corporation, Inc. (USEC)–proposed American Centrifuge Plant (ACP) is known to be more efficient and less energy-intensive than the gaseous-diffusion technology. The GLE laser-based technology is expected to offer certain advantages over both traditional gaseous-diffusion and centrifuge-enrichment processes. Specifically, it is anticipated that the GLE laser-based technology will have lower operating costs and lower capital costs. The GLE laser-based technology also maintains the advantages of two earlier-generation laser-excitation technologies—the Molecular Laser Isotope Separation Process (MLIS) and the Atomic Vapor Isotope Separation Process (AVLIS)—in terms of anticipated high separation factors, low energy intensity, low cooling water requirements, small footprint, and low capital and operating costs. The technological advantages of the GLE laser-based enrichment technology also are expected to result in reduced environmental impacts due to the smaller facility footprint for the same Separative Work Units (SWU) capacity, the lack of chlorofluorocarbon (CFC) use, and lower energy requirements.

1.2 Purpose and Need for the Proposed Action

The purpose of the Proposed Action would be to allow GLE to construct and operate a facility to enrich uranium up to 8% by weight of uranium-235 (^{235}U) using the GLE laser-based technology, with an initial planned maximum target annual production capacity of 6 million SWU. The Proposed Action is intended to satisfy the need for additional reliable and economical domestic sources of enriched uranium supply, particularly as existing aging and less-efficient production facilities cease operation. By supplying enrichment services to commercial nuclear fuel manufacturing plants, the Proposed GLE Facility would support the continued operation of existing nuclear power plants and the future operation of proposed new plants.

As discussed below, the need for the Proposed Action manifests itself in three primary respects:

- The need for enriched uranium to fulfill nuclear electrical-generation requirements
- The need for domestic uranium-enrichment capacity for national energy security
- The need for advanced uranium-enrichment technology in the United States.

The following sections discuss each of these needs and how the Proposed Action serves to meet the needs.

1.2.1 The Need for Enriched Uranium to Fulfill Electricity Requirements

1.2.1.1 Current and Projected Global and U.S. Nuclear Power Generating Capacity

Enriched uranium from the Proposed GLE Facility would be used in fuel for commercial nuclear power plants. Most nuclear reactors are fueled by LEU, which is obtained by mining, converting, and enriching uranium ore and then fabricating it into fuel assemblies. The demand for enriched uranium is thus a function of nuclear power generating capacity. At present, nuclear power plants supply approximately 20% of the nation's electricity requirements (EIA, 2007a). In a 2007 report, the International Energy Agency (IEA) predicted that global primary energy demand will increase by more than 50% by 2030 (IEA, 2007). Additionally, increasing concern over carbon-based energy's deleterious effect on global climate has renewed interest in non-carbon-based energy sources, such as nuclear power. The U.S. Department of Energy (DOE) considers nuclear power as "the only proven technology that can provide abundant supplies of base-load electricity reliably and without air pollution or emissions of greenhouse gases" (CRS, 2007). A recent Congressional Research Service report discusses the impetus for renewed interest in nuclear power expansion in the United States and abroad (CRS, 2007).

At the end of 2006, 435 nuclear power plants were operating in 30 countries; 28 plants were under construction; 64 plants were planned; and 158 plants were proposed (Decker et al., 2007). The International Atomic Energy Agency's (IAEA) Power Reactor Information System indicated that, as of December 2008, there were 439 nuclear power plants (reactor units) in operation, with a total net installed capacity of approximately 372 Gigawatt electrical (GWe; 372,000 Megawatt electrical [MWe]), and 42 plants under construction (IAEA, 2008). **Table 1-1**, which Decker and colleagues (2007) compiled from information provided by the World Nuclear Association (WNA) and IAEA, provides a fairly recent summary of worldwide nuclear electricity generation, uranium requirements, and ongoing or planned new reactor construction. World nuclear generating capacity is projected to rise from 374 GWe (374,000 MWe) in 2005 to 498 GWe (498,000 MWe) in 2030, according to recent projections of the DOE's Energy Information Administration (EIA) (EIA, 2008). According to the EIA, its 2008 projection for nuclear electricity generation in 2025 is 31% higher than the projection it published only 5 years ago in 2003.

The EIA has projected that U.S. electricity consumption will increase at an average rate of 1.0% to 1.5% per year between now and 2030 (EIA, 2007a; EIA, 2008). By end-use sector, from 2005 to 2030, electricity demand is projected to grow by 39% in the residential sector, by 63% in the commercial sector, and by 17% in the industrial sector (EIA, 2007a). EIA projections indicate that the country will need in excess of 300 GWe (300,000 MWe) of new generating capacity by 2030 (EIA, 2007a). To meet this growing demand, installed nuclear power generating capacity in the United States is projected to increase from about 100 GWe (100,000 MWe) in 2004 to about 115 GWe (115,000 MWe) in 2030 (EIA, 2008). This amounts to an increase in U.S. nuclear power generating capacity of more than 10 GWe (10,000 MWe), which is the equivalent of adding about 10 large nuclear power reactors. **Table 1-2** presents the EIA's 2007 forecast for world installed nuclear power generating capacity.

The trend towards increased U.S. nuclear power generating capacity has been apparent for some time. As of September 2008, the NRC had granted 124 electrical power uprates (5,640 Total MWe), was in the process of reviewing 5 uprate applications (519 Total MWe), and expected an additional 43 applications for power uprates (2,958 Total MWe) for the period 2009 to 2013 (NRC, 2008a). As of December 2008, the NRC had approved 26 license-renewal applications (NRC, 2008b). In addition, 13 license-renewal applications were under review at that time, and numerous additional applications were expected to be filed during the 2009–2013 period (NRC, 2008b). Significant improvements in plant efficiency also have

engendered growth in nuclear power generating capacity, as average capacity factor for nuclear power plants has increased from less than 60% in 1980 to about 90% in 2007 (CRS, 2007).

As **Table 1-1** reflects, there are numerous recently announced proposals to construct and operate new advanced reactors in the United States. Current information is available on the NRC Web site. As of December 2008, 17 combined operating license applications for 18 new units already had been submitted to the NRC, and an additional 6 applications for a total of 9 additional new reactor units were expected to be submitted to the NRC by 2010. (NRC, 2008c). **Table 1-3** summarizes the anticipated applicants, reactor sites, and number of new units.

The foregoing trends relative to actual and expected increases in U.S. nuclear power generating capacity indicate an increasing demand for uranium-enrichment services, given that enrichment is an integral step in the nuclear fuel cycle.

1.2.1.2 Global and U.S. Enrichment Demand

1.2.1.2.1 Global Enrichment Requirements

According to the DOE, in 2007, world enrichment demand was estimated to be 45.3 million SWU, which is almost a 3.2% increase over the 2006 level of 43.9 million SWU (U.S. DOE, 2007b). DOE observed that overall world enrichment production and world demand for enrichment have come into very close balance, and that the enrichment market is expected to have little or no excess supply capacity for the near future.

The DOE's observations are consistent with those of recent assessments of enrichment supply and requirements. In reviewing the recent license applications for the proposed LES NEF and USEC ACP, the NRC reviewed a number of relatively recent forecasts and assessments of global uranium-enrichment requirements (Grigoriev, 2002; NUKEM, 2002; Combs, 2004a, 2004b; Cornell, 2005; ESA, 2005; LES, 2005). The NRC's review of these materials is documented in the NEF and ACP final Environmental Impact Statements and in the record of the LES adjudicatory proceeding (NRC, 2005, 2006a, 2006b). The NRC explained that although the United States is a substantial net importer of enriched uranium, it also exports enriched uranium to foreign customers, so global trade in enrichment provides important context for assessing the need for new U.S. enrichment capacity. Additionally, NUREG-1520, the NRC's *Standard Review Plan for the Review of a License Application for Fuel-cycle Facilities,* directs NRC staff to consider the quantities of enriched uranium used for domestic benefit, the projections of domestic and foreign requirements for the services, and the alternative sources of supply for the Proposed GLE Facility's services (NRC, 2005).

As the NRC noted in the NEF and ACP proceedings, supply forecasts typically reflect current sources of enriched uranium, the anticipated loss of supply from diffusion technology facilities like USEC's Paducah Gaseous Diffusion Plant and AREVA's Georges Besse I gaseous-diffusion plant, new supply from the proposed NEF and ACP, and the assumed continuation of current levels of supply from the U.S.–Russian highly enriched uranium (HEU) or "Megatons-to-Megawatts" Agreement (scheduled to expire in 2013). The NRC found that the various forecasts and assessments it reviewed generally indicate that global supply and demand will be in very close balance after 2010, with a clear risk of supply shortfall after 2013, even with increased Russian commercial sales to Europe, potential allowance of Russian commercial sales to the United States, and the combined output of the proposed NEF and ACP at or above their proposed license capacities (NRC, 2005, 2006a, 2006b).

More recent assessments of the global enrichment picture have yielded similar conclusions. Current plans for uranium-enrichment facilities were developed in a nuclear fuel market that is dramatically different from the market that is now evolving and before it became clear that there could be many new nuclear

power plants to fuel (Neff, 2006a, 2007b). Those plans were based on the assumption that uranium would be inexpensive and plentiful, thereby permitting operation of smaller enrichment plants at high tails assays. However, given the sizable increase in uranium prices, many utilities are seeking to specify lower tails assays to conserve uranium (Neff, 2006a, 2006b; Platts, 2007). That approach, however, requires the expenditure of greater SWU (i.e., greater enrichment capacity). The high price and tight supply of uranium is also spawning interest in re-enrichment of depleted uranium tails (Neff, 2006a; Platts, 2007).

Figure 1-5 illustrates the results of the quantitative assessment of Western uranium-enrichment requirements for the year 2015 and reflects the impact of uranium feed tails assay on enrichment requirements. (The September 2005 WNA Reference Case reflected in **Figure 1-5** is summarized in Maeda, 2005.) An expansion of western centrifuge capacity well beyond what is currently planned (e.g., the LES NEF, USEC ACP, and AREVA Georges Besse II plant, and the expansion of Urenco's plants) is necessary to avoid prolonged operation of a gaseous-diffusion plant (e.g., Georges Besse I plant) (Neff, 2006a, 2006b; Platts, 2007). Although western enrichers are looking to Russia to bridge the SWU gap, Russian suppliers are increasingly reluctant to help competitors by "stripping" enriched tails or providing supplemental enrichment supplies (Neff, 2006a). The Russian "Suspension Agreement" historically has limited the availability of Russian SWU to the Western market, and, even in the absence of such trade constraints, political and economic factors (including growing Russian domestic electricity demands) could serve to limit the availability of Russian SWU to the Western market in the future (Beyer, 2005; Mikerin, 2006; Neff, 2006a; U.S. DOC, 2006; Platts, 2007). Deployment of the Proposed GLE Facility could help alleviate the "bottleneck" caused by the shortage of Western enrichment capacity (Saut, 2007).

Energy Resources International, Inc. (ERI) and NUKEM have presented recent publicly available forecasts of global uranium-enrichment supply and requirements (Cornell, 2006; Lohrey, 2006; Schwartz and Meade, 2006). ERI was the principal contributor to the market analysis contained in Section 1.1.2 of the *NEF Environmental Report* (LES, 2005) and previously reviewed by the NRC. **Figure 1-6** of this GLE Environmental Report presents an updated ERI forecast of uranium-enrichment supply requirements. As reflected in **Figure 1-6**, ERI considered two nuclear power growth scenarios: a reference "Moderate Nuclear Growth" scenario and a "High Nuclear Growth" scenario. Under the Moderate Nuclear Growth scenario (which assumes worldwide and U.S. installed nuclear power generating capacities of 460 GWe [460,000 MWe] and 112 GWe [112,000 MWe], respectively, by 2025), annual worldwide enrichment requirements increase 30%, from 45 million to 58 million SWU, by 2025 (Schwartz and Meade, 2006). By comparison, in 2007, the WNA forecasted that annual worldwide enrichment requirements would reach that level (57 to 63 million SWU) by 2015—10 years sooner (WNA, 2008a). Under the High Nuclear Growth scenario (which assumes worldwide and U.S. installed nuclear generating capacities of 570 GWe [570,000 MWe] and 119 GWe [119,000 MWe], respectively, by 2025), annual worldwide enrichment requirements increase 58%, from 45 million to 71 million SWU, by 2025 (Schwartz and Meade, 2006).

Figure 1-6 indicates that even under the ERI Moderate Nuclear Growth scenario, there is little to no margin in enrichment services relative to projected requirements through 2013. **Figure 1-6** also indicates that significant supply gaps are projected to occur after 2013. **Figure 1-6** accounts for currently known or planned elements of base supply (Schwartz and Meade, 2006). ERI also considered potential (not firmly planned) sources of enriched uranium supply, including the following:

1. Expansion of the LES NEF beyond 3 million SWU
2. Expansion of the USEC ACP beyond 3.5 million SWU
3. Expansion of the AREVA Georges Besse II plant beyond 7.5 million SWU
4. Expansion of Urenco European capacity beyond 11 million SWU

5. Additional supply from Russia (Rosatom), assuming trade constraints are relaxed (including redirection of some enrichment capacity from production of natural uranium equivalents)
6. Delayed shutdown of the USEC Paducah and AREVA Georges Besse I gaseous-diffusion plants
7. Possible release of additional U.S. HEU
8. Possible implementation of other commercial enrichment ventures (e.g., the Proposed GLE Facility).

Figure 1-7 shows that even under the Moderate Nuclear Growth scenario, some supply deficit would still exist absent a significant supply contribution from Russia. **Figure 1-8** shows that under the High Nuclear Growth scenario, deficits would exist even with the availability of the Russian SWU.

NUKEM performed a comparable global enrichment market analysis in 2006 (Cornell, 2006; Lohrey, 2006). As **Figures 1-6, 1-7, and 1-8** illustrate, the NUKEM assessment yielded conclusions similar to those of ERI. **Figure 1-9** summarizes NUKEM's forecast for world installed nuclear power generating capacity through 2026. **Figure 1-10** summarizes NUKEM's projection of the enrichment services requirements and supply for reactors through 2026, based on existing and planned enrichment capacity (including the NEF and ACP). Finally, **Figure 1-11** reflects the same projection as **Figure 1-10**, but also considers "prospective" sources of enrichment services. Like ERI, NUKEM forecasts a supply shortfall after 2014, particularly when only existing and currently planned enrichment capacity is considered. As indicated above, the September 2005 WNA Reference Case reflected in these figures is summarized in Maeda (2005).

1.2.1.2.2 U.S. Enrichment Requirements

Even before numerous utilities and consortia announced plans to pursue the construction of new nuclear power plants, in 2003, the EIA forecasted growth in U.S. demand for enriched uranium from 11.5 million SWU in 2002 to 14.2 million SWU in 2025. **Table 1-4** shows actual U.S. enrichment services requirements purchased by owners and operators of U.S. nuclear power plants from 1994 through 2007, as well as the EIA's 2003 forecast for U.S. uranium-enrichment requirements in the United States through 2025. **Table 1-4** indicates that there has been a significant increase (54%) in U.S. enrichment services requirements from 1994 (9.2 million SWU) to 2007 (14.2 million SWU).

The EIA (2003) projected that annual U.S. requirements in 2025 would be 14.2 million SWU. Because the EIA has increased its forecast for 2020 world nuclear power generation capacity since 2003, the above enrichment demand forecasts are clearly conservative (i.e., low). Indeed, as noted above, the total purchases of enrichment services by owners and operators of U.S. civilian nuclear power reactors reached 14.2 million SWU in 2007 (a nearly 6% increase above the 13.4 million SWU reported in 2006). Based on current projections of U.S. installed nuclear power generating capacity, it is likely that U.S. enrichment requirements in 2025 will be significantly higher. In 2006, ERI estimated that annual U.S. requirements for enrichment services will increase to 15.6 million SWU by 2025 under the reference or ERI Moderate Nuclear Growth scenario and to 16.1 million SWU under the ERI High Nuclear Growth scenario (Schwartz and Meade, 2006). This range represents an approximately 11% to 15% increase over current annual U.S. enrichment requirements. NUKEM likewise forecasted U.S. requirements of at least 15 million SWU.

The demand for enriched uranium in the United States is currently being met by three principal sources of supply:

- **Domestic production of enriched uranium**. The only uranium-enrichment facility currently operating in the United States is the Paducah Gaseous Diffusion Plant, run by USEC. The Paducah plant's estimated production in 2007 was about 5.7 million SWU. Due to the

international nature of the enrichment market, a significant portion of Paducah's enrichment (SWU output) is exported, and additional enrichment is imported. One other enrichment facility presently exists in the United States, the Portsmouth Gaseous Diffusion Plant, but it ceased production in May 2001 and is in cold standby (a condition under which the plant could be returned to a portion of its previous production capacity in approximately 18 to 24 months) (U.S. DOE, 2007b). USEC estimated that its 2005 market share constituted over 50% of North American utility demand and 27% of world market share (NRC, 2006a).

- **The Megatons-to-Megawatts Program.** Under this program, which is scheduled to expire in 2013, USEC implements the 1993 intergovernmental agreement between the U.S. and Russia that calls for Russia to convert 500 metric tons (mt; 551 tons) of HEU from dismantled nuclear warheads into LEU. As the U.S. Executive Agent for the HEU Agreement, USEC purchases the enriched portion of the "down blended" material, tests it to make sure it meets specifications, adjusts the enrichment level if needed, and then sells it to its electric utility customers for fuel in commercial nuclear power plants. The activities in the United States all now take place at the Paducah plant (NRC, 2006a). The history, implementation, and current status of the HEU Agreement is described in detail in the DOE's December 2007 report on the effect of the HEU Agreement on the U.S. commercial nuclear fuel market.
- **Other foreign sources.** Other countries that produce and export enriched uranium to the United States include China, France, Germany, the Netherlands, and the United Kingdom. In 2006, specific sellers of enrichment services to owners and operators of U.S. nuclear power reactors included AREVA NC, Inc. (formerly COGEMA, Inc.), CNEIC (China Nuclear Energy Industry Corp.), UG U.S.A., Inc. (the U.S. subsidiary of the German company Urangesellschaft), URENCO, Inc., and USEC, Inc. (EIA, 2007c). The same companies sold enrichment services to U.S. power reactors in 2007, with the exception of UG U.S.A., Inc. and CNEIC.

The current U.S. demand for enriched uranium is approximately 13 to 14 million SWU per year (EIA, 2007c; WNA, 2008b). As noted above, recent forecasts indicate that this demand could reach 15 to 16 million SWU by 2025, depending on the rate of nuclear generation growth in the United States (Lohrey, 2006; Schwartz and Meade, 2006). Annually, USEC produces approximately 10.5 million SWU, of which 6.7 million SWU are sold for use in the United States and 3.8 million SWU are exported (NRC, 2006a). This means that USEC currently fulfills approximately half of the U.S. demand (NRC, 2006a; WNA, 2008b). Of the amount sold for use in the United States, 1.7 million SWU (14% of U.S. demand) come from the Paducah Gaseous Diffusion Plant and 5 million SWU (42% of U.S. demand) come from the Megatons-to-Megawatts Program, which is dependent on deliveries from Russia (NRC, 2006a). Therefore, as EIA (2008) data reflect, about 90% of U.S. demand is currently supplied by foreign sources even though USEC produces approximately 5 million SWU at the Paducah Gaseous Diffusion Plant (NRC, 2006a). **Figure 1-12** illustrates the U.S. enrichment market shares of sellers of enrichment services in 2005.

In view of current and projected trends, existing U.S. sources alone will not be able to provide a dependable and economical domestic supply to meet the growing U.S. demand for enrichment services. New domestic sources of enriched uranium are needed to replace the aging, energy-intensive Paducah Gaseous Diffusion Plant, which will need to be retired in the near future. The Megatons-to-Megawatts Program is scheduled to expire in 2013. As noted above, these two sources meet more than half of the current U.S. demand for LEU.

To help fill the anticipated supply deficit, other potential future sources of supply—both domestic and foreign—have emerged in recent years, including the proposed NEF and ACP, which have received operating licenses from the NRC. LES recently announced a potential plan to expand the annual capacity of its NEF in New Mexico from 3 million SWU to 5.9 million SWU in response to customer expressions

of the need for additional enrichment services (Urenco, 2008). AREVA NC, Inc. has announced its intent to apply in fiscal year 2008 for a license to construct and operate a 3 million SWU/year gas centrifuge enrichment plant in Idaho. Both the NEF and proposed AREVA enrichment facilities plan to use gas centrifuge technology supplied by Enrichment Technology Corporation (ETC), a centrifuge equipment manufacturing company and 50/50 joint venture of Urenco and AREVA NC. Urenco and AREVA NC have announced plans to replace and/or expand their enrichment capacity in Europe using the ETC gas centrifuge technology (U.S. DOE, 2007b).

In February 2008, the United States and Russia (Rosatom) signed a long-term suspension agreement governing trade in nuclear fuel. Prior to the agreement, the only Russian uranium product allowed into the United States for use in nuclear reactors was the LEU down-blended from weapons-grade material under the Megatons-to-Megawatts Program. The new agreement allows Russia to export enriched uranium to the United States in accordance with specific export limits and other terms detailed in the agreement, from 2014 through 2020, with the export of much smaller quantities of enriched uranium permitted from 2011 through 2013 (Spero, 2008; U.S. DOC, 2008; U.S. DOE, 2007b).

The foregoing private sector and U.S. Government initiatives underscore the need for additional sources of supply to meet the growing U.S. and global demand for enrichment services. As discussed above, Neff (2006a), ERI (Schwartz and Meade, 2006), and Lohrey (2006) considered other prospective sources of supply (including the possible export of Russian LEU under relaxed trade constraints), yet still concluded that there is potential for a supply deficit. Based upon information provided by ERI, the DOE similarly concluded in 2007 that supply and demand for enrichment services remain in close balance (U.S. DOE, 2007b).

Figures 1-8 and 1-10 illustrate this point. **Figure 1-13** notably reflects the assumption that the Proposed GLE Facility would be operational in 2011 (Cornell, 2006). Similarly, as illustrated in **Figure 1-14**, Urenco, a major supplier of enrichment services, suggested at a recent fuel-cycle conference that additional enrichment facilities (beyond the NEF and ACP) are critical for meeting the enrichment services requirements. **Figure 1-15** illustrates the need for U.S. enrichment services given the large proportion of services that have been foreign-bought over the past decade. This reflects the broader nuclear industry perspective that diverse domestic sources of enrichment services are needed to avoid potential supply shortfalls and to reduce industry vulnerability to geopolitical disturbances and other sources of supply disruptions. In fact, due to concerns about potential supply shortfalls after 2013, some enrichment buyers have increased contracting lead times. Exelon Corporation and Entergy Corporation, the two largest U.S. nuclear utilities, have signed letters of intent to contract for uranium-enrichment services from GLE.

1.2.2 The Need for Domestic Supplies of Enriched Uranium for National Energy Security

Like the proposed NEF and ACP, the Proposed GLE Facility would play a vital role in assuring the nation's ability to maintain a reliable and economical domestic source of enriched uranium. The U.S. Government has long recognized this important national energy security objective. Indeed, nearly 20 years ago, Congress noted that "domestic enrichment capability is essential for maintaining energy security" (S. Rep. No. 101-60, 101st Congress, 1st Session 8, 20 [1989]) and that "a healthy and strong uranium-enrichment program is of vital national interest" (H.R. Rep. No. 102-474, pt. 2, at 76 [1992]). Specifically, national security interests require assurance that "the nuclear energy industry in the United States does not become unduly dependent on foreign sources of uranium or uranium enrichment services" (S. Rep. No. 102-72, 102d Congress 1st Session 144-45 [1991]). The Energy Policy Act of 1992 expressly cites the "national need to avoid dependence on imports" (42 U.S.C. 2296b-6).

Despite this longstanding Congressional awareness of the strategic importance of the domestic uranium-enrichment industry, the U.S. nuclear energy industry continues to rely increasingly on imports of

enriched uranium. In 1994, 82% (7.5 million/9.2 million SWU) of enrichment services purchased by owners and operators of U.S. civilian nuclear power reactors were of U.S. origin. In 2006, 89% (11.8 million/13.4 million SWU) of the enrichment services purchased were of foreign origin. **Figure 1-15** illustrates this complete turnabout with respect to the provenance of U.S. enrichment services.

The DOE, the agency responsible for developing national energy policy, has recognized this trend and its associated implications. In a 2001 report, the DOE observed that "[w]ith the tightening of world supply and the closure of the Portsmouth Gaseous Diffusion Plant by USEC in May 2001, the reliability of U.S. supply capability has become an important energy security issue" (U.S. DOE, 2001). The DOE expressed concern about a supply disruption from either the Paducah Gaseous Diffusion Plant or the Megatons-to-Megawatts Program and emphasized the importance of "identifying and deploying an economically competitive replacement domestic enrichment capability in the near term" (U.S. DOE, 2001).

In a 2002 letter to the NRC, the DOE indicated that domestic uranium enrichment had fallen from a capacity greater than domestic demand to a level that was less than half of domestic requirements (U.S. DOE, 2002). In this letter, the DOE also

- Referenced interagency discussions, led by the National Security Council, reflecting a clear determination that the United States should promote and maintain a viable and competitive domestic uranium-enrichment industry for the foreseeable future
- Estimated that 80% of projected demand for nuclear power in 2020 could be fueled from foreign sources (absent an expansion of domestic capacity)
- Encouraged the private sector to invest in new uranium-enrichment capacity, insofar as there is sufficient domestic demand to support multiple uranium-enrichment facilities and competition is important to maintain a healthy industry. The industry, for its part, has previously conveyed to the NRC the importance of having multiple domestic enrichment facilities—owned by different entities and deploying different enrichment technologies—to provide diversity and assurance of the fuel supply (Ameren et al., 2002).

More recently, the DOE launched the Global Nuclear Energy Partnership (GNEP) (http://www.gnep.energy.gov), which is a comprehensive strategy to enable the "expanded use of economical, carbon-free nuclear energy to meet growing electricity demand" (U.S. DOE, 2007a). A key element of the GNEP is the establishment of an assured nuclear fuel supply. The *GNEP Strategic Plan* states that if the United States intends to help assure access to nuclear fuel to countries entering the nuclear arena, it must have the capability to provide the needed fuel-cycle services (U.S. DOE, 2007a); however, it concludes that such a capability does not now exist in the United States. The *GNEP Strategic Plan* explains that while the United States was once the "unquestioned leader in enrichment technology," the nation currently meets only a portion of domestic demand with outdated technology and depends on foreign sources for more than 80% of U.S. enriched uranium requirements (U.S. DOE, 2007a).

The Proposed GLE Facility would contribute to the attainment of national energy security policy objectives by providing an additional reliable and economical domestic source of enriched uranium. The Proposed GLE Facility would further both U.S. energy security and GNEP objectives by providing domestic enrichment capacity. Further, this additional capacity would lessen U.S. dependence on foreign sources of enriched uranium.

1.2.3 The Need for State-of-the-Art Uranium-Enrichment Technology in the United States

Both national energy security and the GNEP require the United States to deploy advanced uranium-enrichment technology as soon as practicable. At present, gaseous-diffusion technology is the only technology in commercial use in the United States. Gaseous-diffusion technology has relatively large

resource requirements that make it less attractive than gas centrifuge technology, from both an economic and environmental perspective. Gaseous-diffusion plants require large amounts of power. USEC reports that the cost for electricity to run such plants represents approximately 60% of the total production cost. Two coal-fired power plants routed through four switchyards provide the electrical supply necessary to operate the gaseous-diffusion process at the Paducah plant. In addition to being energy-intensive, a plant using the gaseous-diffusion process requires large-scale use of Freon and non-contact cooling water (NRC, 2006a).

Gas centrifuge technology—the type of technology to be used at the proposed NEF and ACP—is known to be more efficient and substantially less energy-intensive than the gaseous-diffusion technology in use at the Paducah plant. The GLE laser-based technology that would be deployed at the Proposed GLE Facility is expected to offer certain advantages over both the gaseous-diffusion and gas centrifuge processes. Specifically, it is anticipated that the GLE laser-based technology has lower operating costs and lower capital costs, even relative to centrifuge technology (SILEX, 2007a, 2007b). In addition, the GLE laser-based technology has relatively simple and practical separation modules that facilitate greater versatility in deployment (SILEX, 2007a). Finally, the SILEX laser-based technology (and, by extension, the GLE laser-based technology) is the only third-generation laser-based enrichment technology under development (SILEX, 2007a, 2007b). Centrifuge technology, by contrast, is a second-generation mechanical technology. **Table 1-5** provides a comparison of the SILEX laser-based, gas centrifuge, and gaseous-diffusion technologies. The various enrichment technologies are discussed in greater detail in **Section 2.2.1** of this Report (*Elimination of Technology Alternatives*).

Importantly, the U.S. Government has, for many years, sought to facilitate the deployment of laser-based enrichment technology in the United States, including SILEX laser-based technology. Development of the AVLIS and the French SILVA began in the 1970s. In 1985, the U.S. Government identified AVLIS as a potential replacement for the gaseous-diffusion technology. The USEC Privatization Act of 1996 directed USEC, as a private corporation, to continue to assess the economic viability of the AVLIS process and "alternative technologies for uranium enrichment" (42 U.S.C. 2297e). USEC thus continued research and development work on the AVLIS process, but halted development of the AVLIS technology in June 1999 due to a combination of near-term factors that limited its funds (USEC, 2006). These factors included market-driven price declines for enriched uranium, significant cost increases to operate the U.S. gaseous-diffusion plants, and the need to continue shareholder dividends. USEC concluded that expected investment returns were insufficient to outweigh the risks of deploying the new technology (USEC, 1999).

In 1996, USEC also secured the rights to evaluate and develop the SILEX laser-based uranium-enrichment process. USEC continued to support development of the SILEX laser-based technology after it abandoned the AVLIS program due to important advantages associated with the SILEX laser-based technology. During that time, and in order to enable the potential commercial deployment of the SILEX laser-based technology, the United States and Australian governments entered into an Agreement for Cooperation that came into force in May 2001 (SILEX, 2007b). The two governments subsequently officially classified the SILEX laser-based technology; however, USEC ended its support of the SILEX program in 2003 in favor of the proposed ACP for reasons related to USEC's obligations under the DOE-USEC Agreement (USEC, 2003). The rights to develop the SILEX laser-based technology for uranium enrichment reverted back to Silex Systems Limited (USEC, 2003), which has granted GLE exclusive rights to develop and commercialize the SILEX laser-based uranium-enrichment technology (GE, 2006). GLE is seeking to accomplish that objective through the Proposed Action.

In summary, the U.S. Congress, the DOE, and other federal agencies have emphasized the need to deploy state-of-the-art enrichment technology in the United States in the near term, both for national energy

security and commercial reasons. The Proposed Action—construction and operation of the Proposed GLE Facility—would contribute to the realization of this important objective.

1.3 Proposed Action

The Proposed Action is for GLE to construct and operate a uranium-enrichment facility at the existing Wilmington Site in accordance with the Atomic Energy Act of 1954, as amended; 10 CFR 40; 10 CFR 70; and other applicable laws and regulations. During the operations phase of the Proposed Action, the Proposed GLE Facility would be comprised of approximately 100 acres (40 ha) of the Main portion of the GLE Study Area, which is situated within the North-Central Site Sector (**Figure 1-3**). Within these 100 acres (40 ha), there would be an approximately 600,000 ft^2 (56,000 m^2) main GLE operations building, several administrative and other Facility-support buildings, a parking lot, natural and depleted uranium hexafluoride (UF_6) storage areas, and maintained landscaped areas. Within the GLE Study Area, but outside and to the east of the 100-acre (40-ha) Proposed GLE Facility, would be an electrical substation, wastewater lift stations, access roads, guard houses, a water tower, and a stormwater wet detention basin. In addition to this Proposed Action summary, additional Proposed Action details are provided in **Section 2.1.2** of this Report (*Proposed Action*).

The Proposed GLE Facility would use the advanced GLE laser-based technology to separate natural UF_6 feed material containing approximately 0.71 wt. percent ^{235}U into a product stream enriched up to 8 wt. percent ^{235}U and a depleted UF_6 stream containing approximately 0.25 wt. percent ^{235}U. The process is based on excitation by a laser light of UF_6 molecules that contain ^{235}U to separate ^{235}U from uranium-238 (^{238}U). The initial maximum target production capacity at design throughput is 6 million SWU per year.

The Proposed Action includes construction, start up, and operation of process buildings. Facility construction and start up is expected to require 7 years (3 years to initial SWU production, and 4 additional years to escalate to final SWU production capability). Disposition of the depleted uranium tails will likely occur throughout the life of the Facility. The Facility would be initially licensed for 40 years of operation. The following is a list of Proposed Action key dates:

- 2009 – Submittal of license application to the NRC
- 2011 – Anticipated issuance of license by the NRC
- 2011 through 2017 – Construction
- 2013 – Commencement of operations (includes 4-year start-up period of the GLE laser-based technology concurrent with remaining construction activities)
- 2050 – Potential license renewal or decommissioning of the Facility.

At the end of the useful life of the Proposed GLE Facility, the Facility would be decommissioned. Decontamination and decommissioning is projected to take 9 years (2 years of which will overlap with the final years of operation). The impacts of decommissioning are analyzed in **Chapter 4** of this Report, (*Environmental Impacts*); decontamination and decommissioning are also described in **Section 2.1.2.4** of this Report (*Site and Facility Information*).

For the purpose of evaluating the potential environmental impacts that would result from the implementation of the Proposed Action (as presented in **Chapter 4** of this Report, *Environmental Impacts*), impacts are presented for three distinct lifecycle phases. The first phase is the construction phase, which consists of the initial 3 years of construction activities. This phase would entail GLE Facility site preparation and construction of the operations building and auxiliary facilities. The second phase is the operation phase, which would consist of the 4-year start-up period of the GLE laser-based technology and full-scale production for the remaining operating life of the Proposed GLE Facility.

During the start-up period of this phase, some additional construction activities would be expected to continue, primarily inside the buildings. Any impacts associated with these construction activities are addressed as part of the operation-phase environmental impacts. The third and final phase is the decommissioning phase. This phase consists of the scheduled 9-year period of decontamination and closure of the Proposed GLE Facility.

To measure the overall effect of the Proposed Action, aggregate costs and benefits of the project were examined, including both the socioeconomic and environmental effects of the project. Most of the environmental costs and benefits and some of the economic costs and benefits are measured qualitatively, whereas other economic costs and benefits are quantified and valued. Overall, the Proposed GLE Project would be expected to convey positive net benefits.

1.4 Applicable Regulatory Requirements, Permits, and Required Consultations

This section describes the pertinent regulatory framework as it applies to the Proposed GLE Facility. The status of regulatory agency authorizations and consultations is summarized in **Table 1-6**.

1.4.1 Federal Agencies

1.4.1.1 U.S. Nuclear Regulatory Commission

The NRC establishes standards for protection against radiation hazards from licensed activities. NRC licenses are issued pursuant to the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974. The Proposed GLE Facility would have to comply with, among others, the following NRC regulations:

- **10 CFR 20, *Standards for Protection Against Radiation.*** These standards relate to radiation dose limits to individual workers and members of the public.
- **10 CFR 40, *Domestic Licensing of Source Material.*** This regulation establishes the procedures and criteria for the issuance of licenses to receive, possess, use, transfer, or deliver source material.
- **10 CFR 51, *Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions.*** These regulations relate to the submission of the Environmental Report in conjunction with the license application for a nuclear facility.
- **10 CFR 70, *Domestic Licensing of Special Nuclear Material.*** This regulation establishes procedures and criteria for the issuance of licenses to receive title to own, acquire, deliver, receive, possess, use, and transfer special nuclear material.
- **10 CFR 71, *Packaging and Transportation of Radioactive Material.*** This regulation specifies shipping containers and the safe packaging and transportation of radioactive materials under authority of the NRC and DOT. (See also **Section 1.4.1.3** regarding DOT regulation of radioactive material transport.)
- **10 CFR 73, *Physical Protection of Plants and Materials.*** This regulation establishes requirements for physical protection systems for the protection of special nuclear material at fixed sites and in transit and of plants in which special nuclear material is used.
- **10 CFR 74, *Material Control and Accounting of Special Nuclear Material.*** This regulation establishes requirements for control and accounting of special nuclear material, including documentation of transfer of material.
- **10 CFR 95, *Facility Security Clearance and Safeguarding of National Security Information and Restricted Data.*** This regulation establishes procedures for obtaining facility security

clearance and for safeguarding Secret and Confidential National Security Information and Restricted Data received or developed in conjunction with activities licensed, certified, or regulated by the NRC.

1.4.1.2 U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) has primary authority relating to compliance with several statutes and regulations, which are outlined below. EPA has delegated regulatory jurisdiction to the North Carolina Department of Environment and Natural Resources (NCDENR) (see **Section 1.4.2**) for several aspects of permitting, monitoring, and reporting activities relating to these statutes, regulations, and associated programs.

- **40 CFR 190, Subpart B, *Environmental Standards for the Uranium Fuel Cycle.*** These standards establish the maximum doses to the body organs resulting from operational normal releases and received by members of the public.
- **Clean Water Act.** The Clean Water Act (CWA) establishes the basic structure for regulating the discharge of pollutants into the "Waters of the United States." EPA is the principal administrative agency of the CWA; however, responsibilities have been delegated to other federal and state agencies. The CWA establishes water quality standards for contaminants in surface waters, makes it unlawful to discharge pollutants from a point source into navigable waters (unless a permit is obtained), and addresses problems posed by nonpoint-source pollutions. Section 404 of the CWA authorizes the United States Army Corps of Engineers (USACE) to issue permits for the discharge of dredged or fill material into Waters of the United States (see **Section 1.4.1.6**). In North Carolina, implementation and enforcement of Sections 401 and 402 (Water Quality Certification and National Pollutant Discharge Elimination System [NPDES], respectively) of the CWA have been delegated to the NCDENR Division of Water Quality (NC DWQ) (see **Section 1.4.2.1.2**).
- **Clean Air Act.** As amended in 1970, the Clean Air Act (CAA) launched an ambitious national campaign to maintain healthy air quality by controlling air pollution. The 1990 amendments to the CAA renewed and intensified national efforts to reduce air pollution in the United States. In North Carolina, the CAA is implemented by the NCDENR Division of Air Quality (NC DAQ) (see **Section 1.4.2.1.1**).
- **Safe Drinking Water Act .** The Safe Drinking Water Act (SDWA) provides for protection of public water supply systems and underground sources of drinking water. 40 CFR 141.2 (*Definitions – Code of Federal Regulations*) defines public water supply systems as systems that provide water for human consumption to at least 25 people or at least 15 connections. Underground sources of drinking water are also protected from contaminated releases and spills by this act. This act is enforced by the NCDENR Division of Environmental Health, Public Water Supply Section (NC DEH, PWSS) (see **Section 1.4.2.1.4**).
- **Resource Conservation and Recovery Act**
  - **Notification of Regulated Waste Activity.** Section 3010 of Subtitle C of the Resource Conservation and Recovery Act (RCRA) requires any person who generates, transports, or recycles regulated wastes or who owns or operates a facility for the treatment, storage, or disposal of regulated wastes to notify EPA of their activities, including the location and general description of the activities and the regulated wastes handled. This pertains to nonhazardous solid waste and hazardous wastes. RCRA is enforced by the NCDENR Division of Waste Management (NC DWM) (see **Section 1.4.2.1.5**).
  - **Hazardous Waste Generators ID.** Subtitle C of the RCRA regulates hazardous waste generators. A generator is any person or site whose processes and actions create hazardous

waste (see 40 CFR 260.10, *Hazardous Waste Management System – General*). Generators are divided into three categories (i.e., large, small, and conditionally exempt), based upon the quantity of waste they produce per month. Per 40 CFR 262 (*Standards Applicable to Generation of Hazardous Waste*), all large- and small-quantity generators are required to obtain an EPA identification number; this pertains to nonhazardous solid waste and hazardous wastes. RCRA is enforced by the NC DWM (see **Section 1.4.2.1.5**).

- **Emergency Planning and Community Right-to-Know Act of 1986 (40 CFR 350 to 372).** The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA)—also known as SARA Title III—a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by state/tribe and local governments. The EPCRA provisions help increase the public's knowledge and access to information on chemicals at individual facilities, the uses of these chemicals, and their release into the environment. Working with the facilities, states and communities can use the information to improve chemical safety and protect public health and the environment.
- **Noise Control Act of 1972.** The Noise Control Act (42 U.S.C. 6 4901 et seq.) transfers the responsibility of noise control to state and local governments. Commercial facilities are required to comply with federal, state, interstate, and local requirements regarding noise control. In the past, EPA coordinated all federal noise-control activities through its Office of Noise Abatement and Control; however, in 1981, the Administration at that time concluded that noise issues were best handled at the state or local government level. As a result, the EPA phased out the office's funding in 1982 as part of a shift in federal noise-control policy to transfer the primary responsibility of regulating noise to state and local governments. However, the Noise Control Act of 1972 and the Quiet Communities Act of 1978 were not rescinded by Congress and remain in effect today. North Carolina General Statutes § 153A-133 address noise regulation for the state. In addition, New Hanover County enforces a Noise Ordinance (see **Section 1.4.3**).

1.4.1.3 U.S. Department of Transportation

The U.S. Department of Transportation (DOT) requires compliance with the following regulations regarding transport of hazardous materials, including radioactive materials:

- **49 CFR 107, Subpart G, *Hazardous Materials Program Procedures, Registration and Fee to DOT as a Person Who Offers or Transports Hazardous Materials***
- **49 CFR 171, *General Information, Regulations, and Definitions***
- **49 CFR 173, *Shippers — General Requirements for Shipments and Packages,* Subpart I: *Class 7 (Radioactive) Materials***
- **49 CFR 177, *Carriage by Public Highway***
- **49 CFR 178, *Specification for Packagings*** (see also **Section 1.4.1.1** regarding NRC regulation of radioactive material packaging).

1.4.1.4 U.S. Department of Agriculture

The U.S. Department of Agriculture's (USDA's) Natural Resources Conservation Service (NRCS) administers the Farmland Protection Policy Act (FPPA), which is described below.

- **Farmland Protection Policy Act of 1981 (Public Law 97-98, 7 U.S.C. 4201).** The FPPA is intended to minimize the impact that federal programs have on the unnecessary and irreversible conversion of farmland to nonagricultural uses. Federal programs are administered to be compatible with state, local units of government, and private programs and policies to protect

farmland. For the purpose of FPPA, farmland includes prime farmland, unique farmland, and land of statewide or local importance.

1.4.1.5 Advisory Council on Historic Preservation

The Advisory Council on Historic Preservation (ACHP) administers the National Historic Preservation Act (NHPA), described below. The North Carolina State Historic Preservation Office (NC SHPO) administers the national historic preservation program at the State level (see **Section 1.4.2.2.**)

- **National Historic Preservation Act.** As amended (16 U.S.C. 4 470 et seq.), the NHPA was enacted to protect the nation's cultural resources. This act is supplemented by the Archaeological and Historic Preservation Act and directs federal agencies in recovering and preserving historic and archaeological data that would be lost as the result of construction activities.

1.4.1.6 U.S. Army Corps of Engineers

As stated in **Section 1.4.1.2**, the USACE has the responsibility for implementing, permitting, and enforcing provisions of the CWA. Section 404 of the CWA authorizes the USACE to issue permits for the discharge of dredged or fill material into Waters of the United States. The USACE regulatory program is defined in 33 CFR 320–330 (*General Regulatory Policies*). Before an activity occurs, applicable permits must be obtained and any compensatory mitigation must be determined. If the USACE determines that a 404 permit is required because a proposed project involves impacts to wetlands or jurisdictional waters, then a 401 Water Quality Certification is also required. The CWA delegates authority for the issuance of 401 Water Quality Certifications for projects that require federal permits to the states (see **Section 1.4.2.1.2**).

1.4.1.7 U.S. Department of Labor

The U.S. Department of Labor's Occupational Safety & Health Administration (OSHA) regulates mitigation requirements and mandates proper training and equipment for workers. OSHA also administers the Occupational Safety and Health (OSH) Act of 1970, described below.

- **Occupational Safety and Health Act.** The OSH Act is designed to assure the safety of workers in the workplace; provide training, outreach, and education; establish partnerships; and encourage continual improvement in workplace safety and health. OSHA General Industry Regulations are described in 29 CFR 1910 (*Occupational Safety and Health Standards).*

1.4.1.8 U.S. Department of Interior

The U.S Department of the Interior (DOI) is responsible for managing and conserving most of the nation's federally owned lands.

- **Endangered Species Act.** Section 7 of the Endangered Species Act (ESA) (7 U.S.C. § 136 and 16 U.S.C. § 1531–1534) requires that any action likely to adversely affect a species classified as federally protected be subject to review by the DOI's U.S. Fish and Wildlife Service (FWS). The purpose of the ESA of 1973, as amended, is to help preserve the nation's valuable plant and wildlife resources that are imperiled. The ESA provides a means to help preserve these species and their habitats for future generations. Other species may receive additional protection under separate laws. The FWS works in coordination with the North Carolina Wildlife Resources Commission to implement the ESA (see **Section 1.4.2.11.**)
- **Federal Land Policy and Management Act of 1976.** As amended (43 U.S.C. 1701 et seq.), the Federal Land Policy and Management Act outlines functions of the Bureau of Land Management (BLM). The BLM's mission is to sustain the health, diversity, and productivity of the public lands. There are no public lands managed by the BLM in North Carolina (BLM, 2000).

- **The Bureau of Indian Affairs.** The Bureau of Indian Affairs is responsible for the administration and management of 55.7 million acres (22.5 million ha) of land held in trust by the United States for American Indians, Indian tribes, and Alaska Natives. There are 561 federally recognized tribal governments in the United States; however, there are no impacts on tribal lands from the Proposed Action (see **Section 3.1.3** of this Report, *Special Land Use Classifications*).

1.4.2 State Agencies

1.4.2.1 North Carolina Department of Environment and Natural Resources

NCDENR is the lead stewardship agency for the preservation and protection of North Carolina's natural resources and administers regulatory programs designed to protect air quality, water quality, and the public's health. The general and specific permits and permit requirements are discussed below with respect to the responsible NCDENR division.

1.4.2.1.1 North Carolina Division of Air Quality

The NC DAQ is responsible for protecting and improving outdoor (ambient) air quality in North Carolina for the health and benefit of the public. The NC DAQ conducts "programs for monitoring air quality, permitting and inspecting air emissions sources, developing plans for improving air quality, and educating and informing the public about air quality issues" (NC DAQ, 2008).

- **Air Quality Permits.** Air quality permits are legally enforceable documents that specify requirements based on applicable federal and State regulations, which facility owners and operators must meet to control air emissions from sources operating at their facilities. The NC DAQ issues individual air quality permits to facility owners and operators for the construction and operation of air emissions sources in North Carolina. Before construction and operation of a facility with stationary air emissions sources can begin in North Carolina, the owner or operator must apply for and receive an approved air quality permit from the NC DAQ. The type of air quality permit issued by the NC DAQ to a facility depends on the total annual quantities of criteria and hazardous/toxic air pollutants that the facility would have the potential to emit.

1.4.2.1.2 North Carolina Division of Water Quality

The NC DWQ is responsible for statewide regulatory programs in groundwater and surface water protection. The following permits are regulated by the NC DWQ:

- **401 Water Quality Certification.** The EPA has delegated authority to North Carolina to issue a CWA 401 Water Quality Certification for projects that require a 404 permit. A 401 Water Quality Certification is verification by the State that the project will not degrade State Waters or violate water quality standards. A 401 Water Quality Certification is required before the USACE can issue a 404 permit.
- **Isolated Wetlands Permit.** An Isolated Wetlands permit is needed when the USACE determines that a wetland that potentially would be impacted is not a 404 jurisdictional wetland.
- **NPDES Individual Permit for Industrial Stormwater.** In compliance with Section 402 of the CWA, a permit is required for discharge of stormwater runoff from industrial or commercial facilities to the Waters of the United States. All new and existing point-source industrial stormwater discharges associated with industrial activity require a NPDES Stormwater Permit.
- **NPDES Individual Permit for Industrial and Sanitary Wastewater.** In compliance with Section 402 of the CWA, this permit is required for the point-source discharge of process and sanitary wastewater to surface waters.

- **NPDES Individual Permit for Construction Stormwater.** Prior to commencement of any construction activities, an authorization to construct is required. The issuance of a NPDES permit for construction activities is tied to submission of an Erosion and Sedimentation Control Plan to the North Carolina Division of Land Resources (see also **Section 1.4.2.1.8**). The conditions of this permit include adherence to the Erosion and Sedimentation Control Plan, regular inspection of best management practices and outfalls, and regular maintenance of structures. An individual NPDES permit for stormwater discharge from construction activities would be required before GLE Facility site preparation and construction activities could begin. Development of a Stormwater Pollution Prevention Plan and filing a Notice of Intent with the EPA at least 2 days prior to the commencement of construction activities is necessary.
- **Administrative Code Section 15A NCAC 2T, *Waste Not Discharged to Surface Waters.*** Gravity sewer main extensions and new sanitary sewer pump stations handling wastewater generated from potable water will require a permit from the NC DWQ.

1.4.2.1.3 North Carolina Division of Water Resources

The North Carolina Division of Water Resources (NC DWR) administers programs for river basin management, water supply assistance, water conservation, and water resources development (NC DWR, 2008) and administers the following statute, applicable to the plans for the Proposed GLE Facility:

- **North Carolina General Statutes § 143-215.22H.** This statute requires water users to register their water withdrawals and to update those registrations at least every 5 years if they meet certain criteria. The groundwater withdrawals at the Wilmington Site have been registered with NCDENR because these are non-agricultural water uses that withdraw 100,000 gallons (378,541 liters) or more of groundwater in any one day.

1.4.2.1.4 North Carolina Division of Environmental Health, Public Water Supply Section

The NC DEH, PWSS regulates public water systems within the State under the statutory authority of the following:

- **North Carolina General Statutes § 130A-328.** This statute requires that all community and non-transient non-community water systems have a permit to operate. A community water system is defined as a public water system that serves 15 or more service connections or regularly serves 25 or more year-round residents. A non-transient, non-community system is a public water system that is not a community water system and that regularly serves at least 25 of the same persons over 6 months per year.

1.4.2.1.5 North Carolina Division of Waste Management

The Hazardous Waste Section of the NC DWM administers the RCRA program for the State of North Carolina under the statutory authority of the North Carolina Solid Waste Management Act, N.C.G.S. 130A Article 9, and the Rules codified at 15A NCAC 13A. The following are RCRA permits/programs implemented by NC DWM that will apply during Proposed GLE Facility operations:

- **Hazardous Waste Generator Identification Number Requirement.** Most hazardous waste generators are required to obtain an EPA identification number from the State. This number is site-specific.
- **Hazardous Waste Management Treatment, Storage, and Disposal Facility Permit**. This permit is for the operation of a treatment, storage, or disposal facility for the management of hazardous waste. Often called a TSD Permit, this permit is obtained from EPA.
- **Hazardous Waste Transporter Identification Number Requirement.** Transport of hazardous waste requires an EPA identification number, which can be obtained from the State. This number

is operator-specific. Receipt of an identification number requires compliance with all applicable DOT regulations (49 CFR 171-179, *Pipeline and Hazardous Materials Safety Administration, Department of Transportation*) (see **Section 1.4.1.3**.)

1.4.2.1.6 North Carolina Radioactive Materials Branch

Serving under NCDENR, the Radioactive Materials Branch regulates the possession, use, transfer, transportation, and disposal of radioactive material within the State of North Carolina. The regulation consists of a licensing program and an inspection program.

- **Radioactive Material License.** This license covers the receiving, possession, use, transfer, acquiring of, or ownership of radioactive material.

1.4.2.1.7 North Carolina Division of Coastal Management

The NC DCM carries out the federal Coastal Zone Management Act of 1972, which has been incorporated into the State's Coastal Area Management Act (CAMA) in the 20 coastal counties, including New Hanover County.

- **Coastal Area Management Act Permit (Federal Consistency).** In general, a CAMA permit would be required for an action that would be conducted within or affects an Area of Environmental Concern (AEC).

1.4.2.1.8 North Carolina Division of Land Resources

The North Carolina Division of Land Resources is composed of the North Carolina Land Quality Section, the North Carolina Geologic Survey, and the North Carolina Geodetic Survey. An Erosion and Sedimentation Control Plan is required by this division under the circumstances described below.

- **Erosion and Sedimentation Control Plan.** An Erosion and Sedimentation Control Plan needs to be prepared, submitted, and approved prior to the commencement of any land-disturbing activity that affects one or more acres (.4 or more ha) of land. A land-disturbing activity results in a change in the natural cover or topography that may cause or contribute to sedimentation. This plan is tied to the NPDES Individual Permit for Construction Stormwater (see **Section 1.4.2.1.2**), and this program is administered by the New Hanover County Soil and Erosion Control Department (see **Section 1.4.3**).

1.4.2.1.9 North Carolina Wildlife Resource Commission

The North Carolina Wildlife Resource Commission works in coordination with the FWS on the protection of Threatened and Endangered Species and implementation of the ESA.

1.4.2.1.10 North Carolina Division of Parks and Recreation, Natural Heritage Program

The Division of Parks and Recreation, Natural Heritage Program inventories, catalogues, and supports conservation of the rarest and the most outstanding elements of the natural diversity of the State and is a resource for ecological resources information.

1.4.2.1.11 North Carolina Division of Forest Resources

The North Carolina Division of Forest Resources (NC DFR) is directed by Chapters 77, 113, and 143 of the North Carolina General Statutes and by Title 15, Chapter 9, of the North Carolina Administrative Code to protect, manage, and develop the forest resources of the State. The processes used to accomplish this mandate involve management of existing resources, development and creation of new and better forests, and protection of these valuable resources.

1.4.2.2 North Carolina Department of Cultural Resources

The NC SHPO implements Section 106 of the NHPA of 1966, which provides that archeological sites listed in or eligible for listing in the National Register of Historic Places be considered in the planning of federal undertakings. The NC SHPO reviews archaeological surveys conducted to identify and evaluate the significance of archaeological remains that may be damaged or destroyed by an action. If a federal undertaking is in conflict with the preservation of a historic property, the NC SHPO seeks to eliminate or minimize the effect on the property through mitigation procedures.

1.4.2.3 North Carolina Department of Transportation

The North Carolina Department of Transportation will require a driveway permit for road connections.

1.4.3 Local Agencies

1.4.3.1 New Hanover County Planning Department

- **New Hanover County Tree Removal Permit.** The removal of any regulated tree from public or private property requires a tree removal permit from the County Zoning Administrator. The tree removal permit is required before any clearing, grading, or other authorizations may be issued, including issuance of soil and sedimentation control permits and building permits (New Hanover County Code; Article VI-10, Section 67-9, *Tree Removal* [7/01]).
- **New Hanover County Noise Ordinance.** New Hanover County enforces a Noise Ordinance (New Hanover County Municipal Code, Article III).

1.4.3.2 New Hanover County Engineering Department

- **New Hanover County Permit for a Land-Disturbing Activity.** All development within New Hanover County is subject to the New Hanover County Erosion and Sedimentation Control Ordinance issued pursuant to the North Carolina Sedimentation Pollution Control Act of 1973. A Land-Disturbing Permit, which includes the submittal of an Erosion and Sedimentation Control Plan, would be required prior to the commencement of any land-disturbing activity that affects one or more acres (.4 or more ha) of land (see **Section 1.4.2.1.8)**.
- **New Hanover County Stormwater Permit.** New Hanover County adopted a Stormwater Ordinance in September 2000 (New Hanover County Code; Chapter 23, *Environment*; Article VII, *Stormwater Management*). It is the county policy that all land to be developed within the unincorporated areas of the county shall have sufficient stormwater-management controls to provide adequate protection of life, property, and natural resources. At a minimum, regulated activities shall include sufficient management of post-development runoff from the 2-year, 10-year, and 25-year frequency storms, such that the discharge rates of post-development stormwater runoff do not exceed the pre-developed rates.
- **New Hanover County Floodplain Development Permit.** Any development activities within Special Flood Hazard Areas and Future Conditions Flood Hazard Areas (as determined by the State of North Carolina and the Federal Emergency Management Agency [FEMA] in its Flood Insurance Study and its accompanying Flood Insurance Rate Maps) are subject to the New Hanover County Flood Damage Prevention Ordinance. A Floodplain Development Permit would be required prior to the commencement of any development activities in these designated areas.

1.4.4 Consultations and Authorizations

GLE is establishing an implementation plan and schedule to ensure compliance with the regulatory requirements, permits, and required consultations described in this section. No administrative delays or

other problems preventing agency consultation, review, approval, or authorization are anticipated. In advance of submission of this Report, GLE has begun consulting with the responsible agencies in compliance with the following:

- Section 404 of the CWA, jurisdictional determination of Waters of the United States (USACE)
- Section 7 of the ESA (FWS)
- Federal Coastal Zone Management Act and NC CAMA (NC DCM)
- Section 106 of the NHPA (NC SHPO)
- Driveway and Right-of-Way Permits, 19A NCAC 02 (NC DOT).

Consultation letters and responses are included in **Appendix B** of this Report (*Regulatory Correspondence*). The status of regulatory agency authorizations and consultations is summarized in **Table 1-6**.

Tables

Table 1-1. World Nuclear Power Reactors 2005–2007 and Uranium Requirements

Country	Nuclear Electricity Generation 2005		January 2007								
			Reactors Operable		Reactors Under Construction		Reactors Planned		Reactors Proposed		Uranium Required 2007
	Billion kWh	% electrical power	No.	MWe	No.	MWe	No.	MWe	No.	MWe	tonnes U
Argentina	6.4	6.9	2	935	1	692	0	0	1	700	135
Armenia	2.5	43	1	376	0	0	0	0	1	1000	51
Belgium	45.3	56	7	5728	0	0	0	0	0	0	1079
Brazil	9.9	2.5	2	1901	0	0	1	1245	4	4000	338
Bulgaria	17.3	44	2	1906	0	0	2	1900	0	0	255
Canada	86.8	15	18	12595	2	1540	2	2000	0	0	1836
China	50.3	2.0	10	7587	5	4170	13	12920	50	35880	1454
Czech Republic	23.3	31	6	3472	0	0	0	0	2	1900	550
Egypt	0	0	0	0	0	0	0	0	1	600	0
Finland	22.3	33	4	2696	1	1600	0	0	0	0	472
France	430.9	79	59	63473	0	0	1	1630	1	1600	10368
Germany	154.6	31	17	20303	0	0	0	0	0	0	3486
Hungary	13.0	37	4	1773	0	0	0	0	0	0	254
India	15.7	2.8	16	3577	7	3178	4	2800	15	11100	491
Indonesia	0	0	0	0	0	0	0	0	4	4000	0
Iran	0	0	0	0	1	915	2	1900	3	2850	143
Israel	0	0	0	0	0	0	0	0	1	1200	0
Japan	280.7	29	55	47700	2	2285	11	14945	1	1100	8872
Kazakhstan	0	0	0	0	0	0	0	0	1	300	0
Korea DPR (North)	0	0	0	0	0	0	1	950	0	0	0
Korea RO (South)	139.3	45	20	17533	1	950	7	8250	0	0	3037
Lithuania	10.3	70	1	1185	0	0	0	0	1	1000	134
Mexico	10.8	5.0	2	1310	0	0	0	0	2	2000	257
Netherlands	3.8	3.9	1	485	0	0	0	0	0	0	112

(continued)

Table 1-1. World Nuclear Power Reactors 2005–2007 and Uranium Requirements (continued)

	Nuclear Electricity Generation 2005		January 2007								
			Reactors Operable		Reactors Under Construction		Reactors Planned		Reactors Proposed		Uranium Required 2007
Country	Billion kWh	% electrical power	No.	MWe	No.	MWe	No.	MWe	No.	MWe	tonnes U
Pakistan	1.9	2.8	2	400	1	300	2	600	2	2000	64
Romania	5.1	8.6	1	655	1	655	0	0	3	1995	92
Russia	137.3	16	31	21743	3	2650	8	9600	18	21600	3777
Slovakia	16.3	56	5	2064	0	0	2	840	0	0	299
Slovenia	5.6	42	1	696	0	0	0	0	1	1000	145
South Africa	12.2	5.5	2	1842	0	0	1	165	24	4000	332
Spain	54.7	20	8	7442	0	0	0	0	0	0	1473
Sweden	69.5	45	10	8975	0	0	0	0	0	0	1468
Switzerland	22.1	32	5	3220	0	0	0	0	0	0	575
Turkey	0	0	0	0	0	0	3	4500	0	0	0
Ukraine	83.3	49	15	13168	0	0	2	1900	0	0	2003
United Kingdom	75.2	20	19	10982	0	0	0	0	0	0	2021
USA	780.5	19	103	98254	1	1200	2	2716	21	24000	20050
Vietnam	0	0	0	0	0	0	0	0	2	2000	0
World	2626	16	435	368,860	28	22,735	64	68,861	158	124,225	66,529

Notes: kWh = Kilowatt-hour.

MWe = Megawatt net (electrical as distinct from thermal).

Reference: Decker et al., 2007 (based on information from the World Nuclear Association and International Atomic Energy Agency).

Table 1-2. EIA 2008 Projection of World Installed Nuclear Power Generating Capacity by Region and Country, 2005–2030 (Gigawatts)

Region/Country	History	Projections					Average Annual Change, 2005–2030
	2005	2010	2015	2020	2025	2030	
Organization for Economic Co-operation and Development (OECD) Member Countries							
OECD North America	**114**	**117**	**119**	**128**	**134**	**134**	**0.6**
United States[a]	100	101	102	111	116	115	0.6
Canada	13	15	15	16	17	18	1.4
Mexico	1	1	1	1	1	1	0.1
OECD Europe	**133**	**129**	**126**	**114**	**116**	**118**	**-0.5**
OECD Asia	**64**	**67**	**74**	**80**	**84**	**88**	**1.3**
Japan	47	49	52	54	56	58	0.8
South Korea	17	18	22	26	28	30	2.4
Australia/New Zealand	0	0	0	0	0	0	—
Total OECD Countries	**311**	**313**	**318**	**323**	**334**	**341**	**0.4**
Non-OECD Member Countries							
Non-OECD Europe and Eurasia	**43**	**42**	**46**	**57**	**65**	**66**	**1.7**
Russia	23	23	27	33	40	41	2.3
Other	20	19	19	24	25	25	1.0
Non-OECD Asia	**15**	**21**	**40**	**59**	**75**	**83**	**7.0**
China	7	9	22	35	45	52	8.5
India	3	5	9	14	18	20	8.2
Other Non-OECD Asia	6	6	8	10	12	11	2.8
Middle East	**0**	**0**	**1**	**1**	**1**	**1**	—
Africa	**2**	**2**	**2**	**2**	**3**	**3**	**1.9**
Central and South America	**3**	**3**	**4**	**5**	**5**	**5**	**1.6**
Brazil	2	2	3	3	3	3	1.6
Other Central and South America	1	1	1	2	2	2	1.6
Total Non-OECD Countries	**63**	**68**	**93**	**124**	**148**	**157**	**3.7**
Total World	374	381	411	446	482	498	1.1

[a] Includes the 50 states and the District of Columbia.

Note: Totals may not equal sum of components due to independent rounding.

References:

History: Derived from Energy Information Administration (EIA), International Energy Annual 2005 (June-October 2007), Web site www.eia.doe.gov/iea. Projections: EIA, Annual Energy Outlook 2008, DOE/EIA-0383 (2008) (Washington, DC, June 2008), AEO2008 National Energy Modeling System, run AEO2008.D030208F, Web site www.eia.doe.gov/oiaf/aeo; and System for the Analysis of Global Energy Markets (2007) EIA, 2008 (Table H.5).

Table 1-3. Expected New U.S. Nuclear Power Plant Applications as of December 8, 2008

Company[a]	Date of Application	Design	Date Accepted	Site Under Consideration	State	Existing Operating Plant
Calendar Year (CY) 2007 Applications						
NRG Energy (52-012/013)[c]	09/20/2007	ABWR	11/29/2007	South Texas Project (2 units)	TX	Y
NuStart Energy (52-014/015)[c]	10/30/2007	AP1000	01/18/2008	Bellefonte (2 units)	AL	N
UNISTAR (52-016)[c]	07/13/2007 (Envir.) 03/13/2008 (Safety)	EPR	01/25/2008	Calvert Cliffs (1 unit)	MD	Y
Dominion (52-017)[c]	11/27/2007	ESBWR	01/28/2008	North Anna (1 unit)	VA	Y
Duke (52-018/019)[c]	12/13/2007	AP1000	02/25/2008	William Lee Nuclear Station (2 units)	SC	N
2007 Total Number of Applications = 5 Total Number of Units = 8						
Calendar Year (CY) 2008 Applications						
Progress Energy (52-022/023)[c]	02/19/2008	AP1000	04/17/2008	Harris (2 units)	NC	Y
NuStart Energy (52-024)[c]	02/27/2008	ESBWR	04/17/2008	Grand Gulf (1 units)	MS	Y
Southern Nuclear Operating Co. (52-025/026)[c]	03/31/2008	AP1000	05/30/2008	Vogtle (2 units)	GA	Y
South Carolina Electric & Gas (52-027/028)[c]	03/31/2008	AP1000	07/31/2008	Summer (2 units)	SC	Y
Progress Energy (52-029/030)[c]	07/30/2008	AP1000	10/06/2008	Levy County (2 units)	FL	N
Exelon (52-031/032)[c]	09/03/2008	ESWBR	10/29/2008	Victoria County (2 units)	TX	N
Detroit Edison (52-033)[c]	09/18/2008	ESBWR	11/25/2008	Fermi (1 unit)	MI	Y
Luminant Power (52-034/035)[c]	09/19/2008	USAPWR	12/2/2008	Comanche Peak (2 units)	TX	Y
Entergy (52-036)[c]	09/25/2008	ESBWR	12/4/2008	River Bend (1 unit)	LA	Y
AmerenUE (52-037)[c]	07/24/2008	EPR	12/4/2008	Callaway (1 unit)	MO	Y
UNISTAR (52-038)[c]	09/30/2008	EPR	12/4/2008	Nine Mile Point (1 unit)	NY	Y
PPL Generation (762)[b]	10/10/2008	EPR		Bell Bend (1 unit)	PA	Y
2008 Total Number of Applications = 12 Total Number of Units = 18						

Company[a]	Date of Application	Design	Date Accepted	Site Under Consideration	State	Existing Operating Plant
Calendar Year (CY) 2009 Applications						
Florida Power and Light (763)		AP1000		Turkey Point (2 units)	FL	Y
Amarillo Power (752)		EPR		Vicinity of Amarillo (2 units)	TX	UNK
Alternate Energy Holdings (765)		EPR		Hammett (1 unit)	ID	N
2009 Total Number of Applications = 3 Total Number of Units = 5						
Calendar Year (CY) 2010 Applications						
Blue Castle Project		TBD		Utah	UT	N
Unannounced		TBD		TBD	TBD	UNK
Unannounced		TBD		TBD	TBD	UNK
2010 Total Number of Applications = 3 Total Number of Units = 4						
2007–2010 Total Number of Applications = 23 Total Number of Units = 34						

[a] Numbers in parentheses are Project Numbers/Docket Numbers.
[b] Acceptance review ongoing.
[c] Accepted/docketed.
Reference: NRC, 2008c.
ABWR = Advanced Boiling Water Reactors.
AP1000 = Westinghouse Pressurized Water Reactor.
EPR = Evolutionary Pressurized Water Reactor.
ESBWR = GE Economic Simplified Boiling Water Reactor.
USAPWR = U.S. Advanced Pressurized Water Reactor.

Table 1-4. Actual and Projected Uranium-Enrichment Demand in the United States

Year	Million Separative Work Units (SWU)
Actual Annual U.S. Enrichment Requirements [a]	
1994	9.2
1995	9.5
1996	11.2
1997	8.9
1998	10.1
1999	10.0
2000	11.8
2001	10.4
2002	11.5
2003	12.0
2004	11.8
2005	11.4
2006	13.4
2007	14.2
EIA 2003 Forecasted Annual U.S. Enrichment Requirements [b]	
2010	12.9
2015	15.4
2020	13.5
2025	14.2

[a] EIA, 2007c.
[b] EIA, 2003.
References: EIA, 2003, 2008

Table 1-5. Comparison of SILEX with Other Uranium-Enrichment Technologies

	SILEX	Centrifuge	Gas Diffusion
Developed	2000s	1940s	1940s
Process	Laser Excitation	Mechanical (centrifugal force)	Mechanical
Enrichment Efficiency	Significantly higher[a]	1.3	1.004
Cost Comparison	Potentially Attractive	Capital Intensive	Very expensive
Percentage of Existing Market[b]	0%	54%	33%
Status	Third generation under scale-up	Proven second generation	Obsolescent first generation

[a] This number is classified. The range indicated is dictated by the technology Classification Guide.

[b] Approximately 13% supplied via Russian highly enriched uranium (HEU) material.

Reference: SILEX, 2007a

Table 1-6. Status of Regulatory Agency Authorizations and Consultations

Agency	Authority	Activity	Status
Federal Agencies			
U.S. Nuclear Regulatory Commission	Atomic Energy Act of 1954, as amended	Facility license	License application (including this Report) submitted
U.S. Army Corps of Engineers	Clean Water Act	Jurisdictional determination of Waters of the United States	Jurisdictional determination obtained (see Appendix B)
		Section 404 permit	To be obtained
U.S. Fish and Wildlife Service	Endangered Species Act, Section 7	Concurrence on impact assessment	Initial consultation completed (see Appendix B); final concurrence to be obtained
State Agencies			
North Carolina Division of Air Quality	Clean Air Act	Construction and Operating Permit	To be obtained
North Carolina Division of Water Quality	Clean Water Act	Section 401 Water Quality Certification	To be obtained
		NPDES Individual Permit for Construction Stormwater Management	To be obtained
		NPDES Individual Permit for Stormwater Management (operations)	Existing Wilmington Site permit to be modified
		NPDES Individual Permit for Industrial and Sanitary Wastewater Treatment	Existing Wilmington Site permit to be modified
	15 NCAC 02H .1300 – Discharges to Isolated Wetlands and Isolated Waters	Isolated Wetlands Permit	Need for permit dependent on final Facility design
North Carolina Division of Waste Management	Resource Conservation and Recovery Act	Hazardous Waste Generator Identification Number (EPA ID No)	To be obtained
North Carolina Radioactive Materials Branch	15 NCAC 11 – Radiation Protection	Radioactive Materials License	To be obtained
North Carolina Division of Coastal Management	Coastal Area Management Act	Permit requirement determination	Need for permit dependent on final Facility design (see Appendix B)
North Carolina Department of Cultural Resources	National Historic Preservation Act	Consultation on presence and significance of archeological sites	Consultation complete (see Appendix B)
North Carolina Department of Transportation	19A NCAC 02	Driveway and Right-of-Way Permits	To be obtained
Local Agencies			
New Hanover County	New Hanover County Ordinances	Tree Removal Permit	Need for permit dependent on final Facility design
		Permit for a Land-Disturbing Activity	To be obtained
		Stormwater Permit	To be obtained
		Floodplain Development Permit	Need for permit dependent on final Facility design

Figures

Figure 1-1. Wilmington Site location.

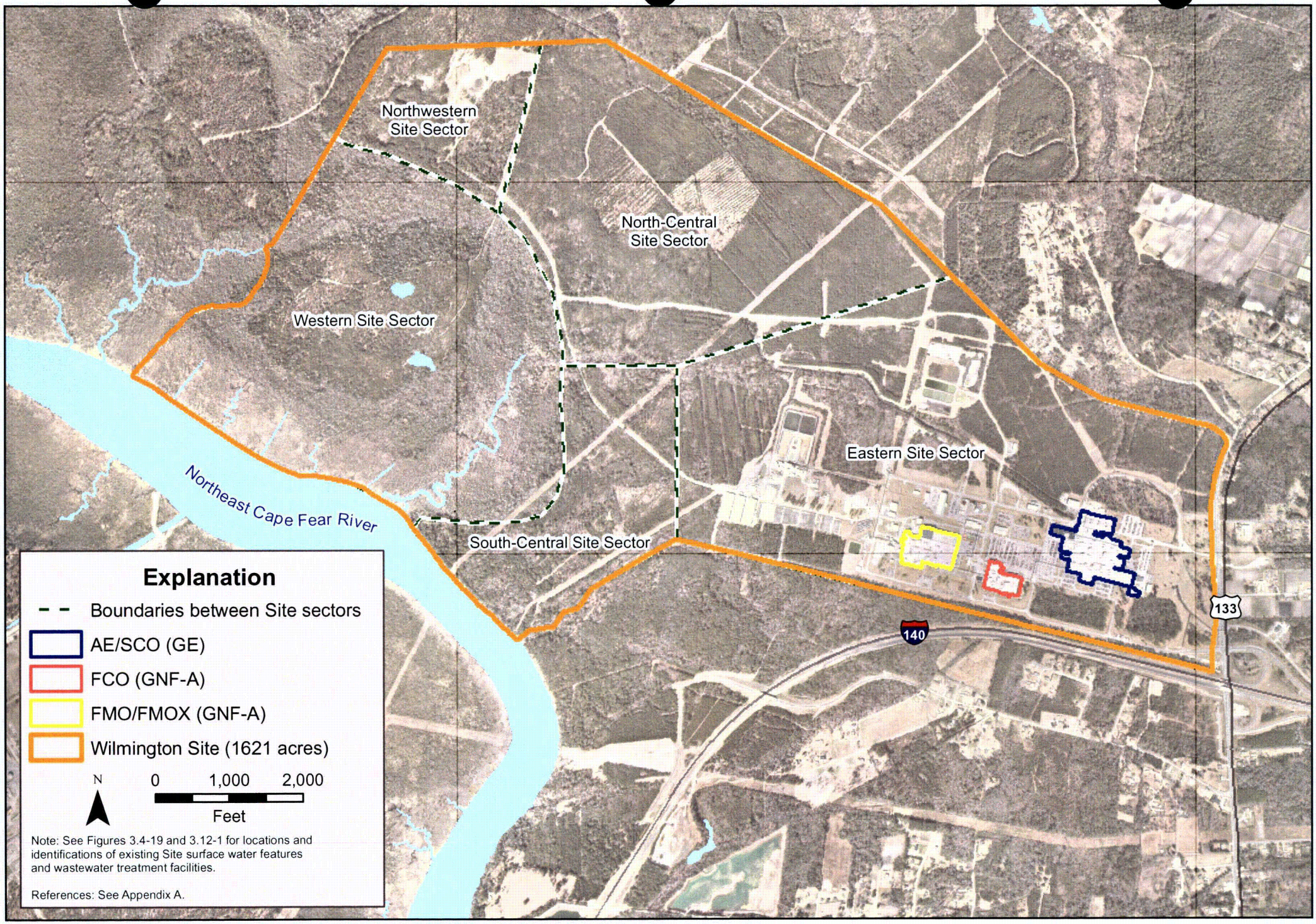


Figure 1-2. Wilmington Site sectors for reference in Environmental Report.

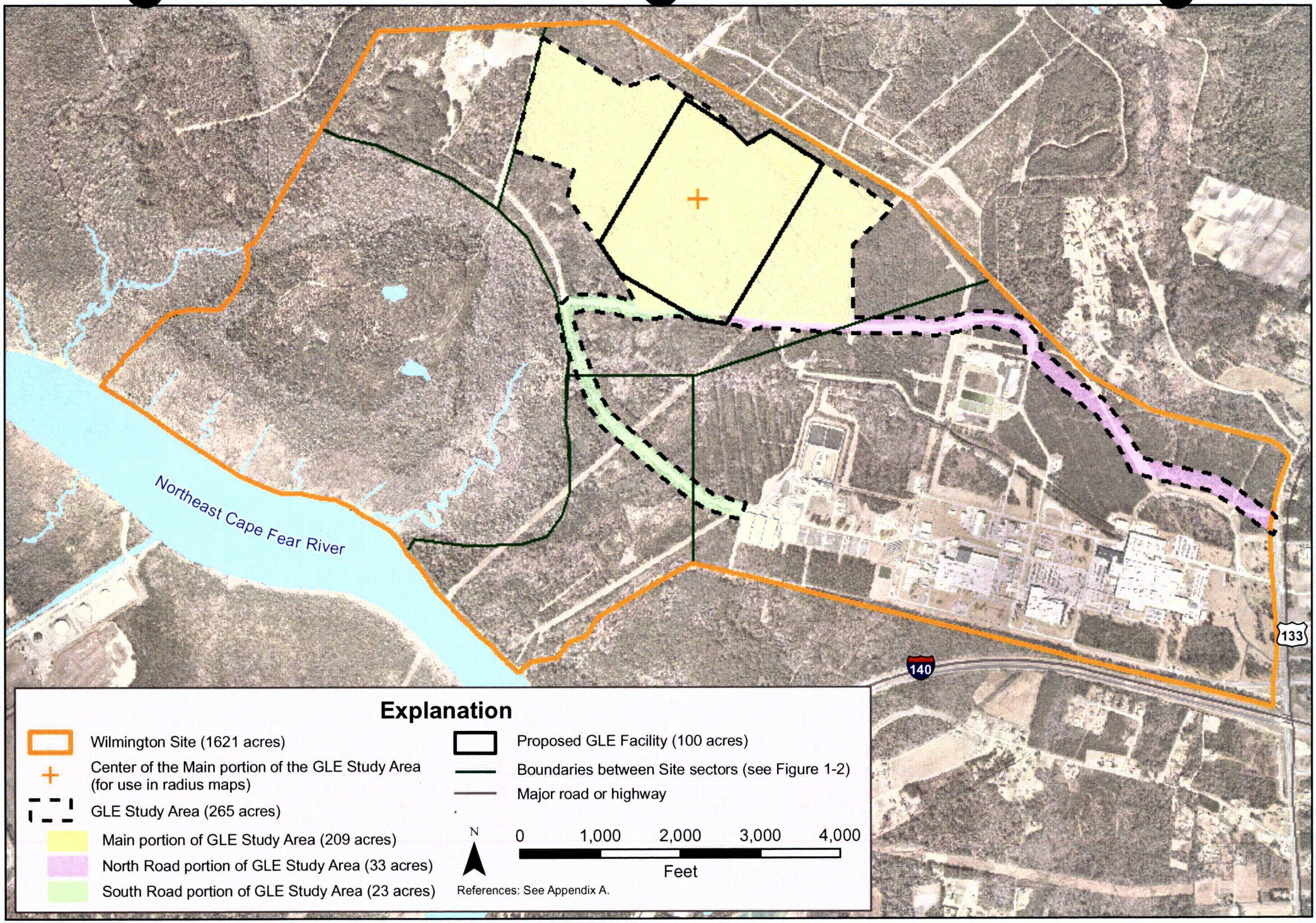


Figure 1-3. Location of the GLE Study Area and Proposed GLE Facility at the Wilmington Site.

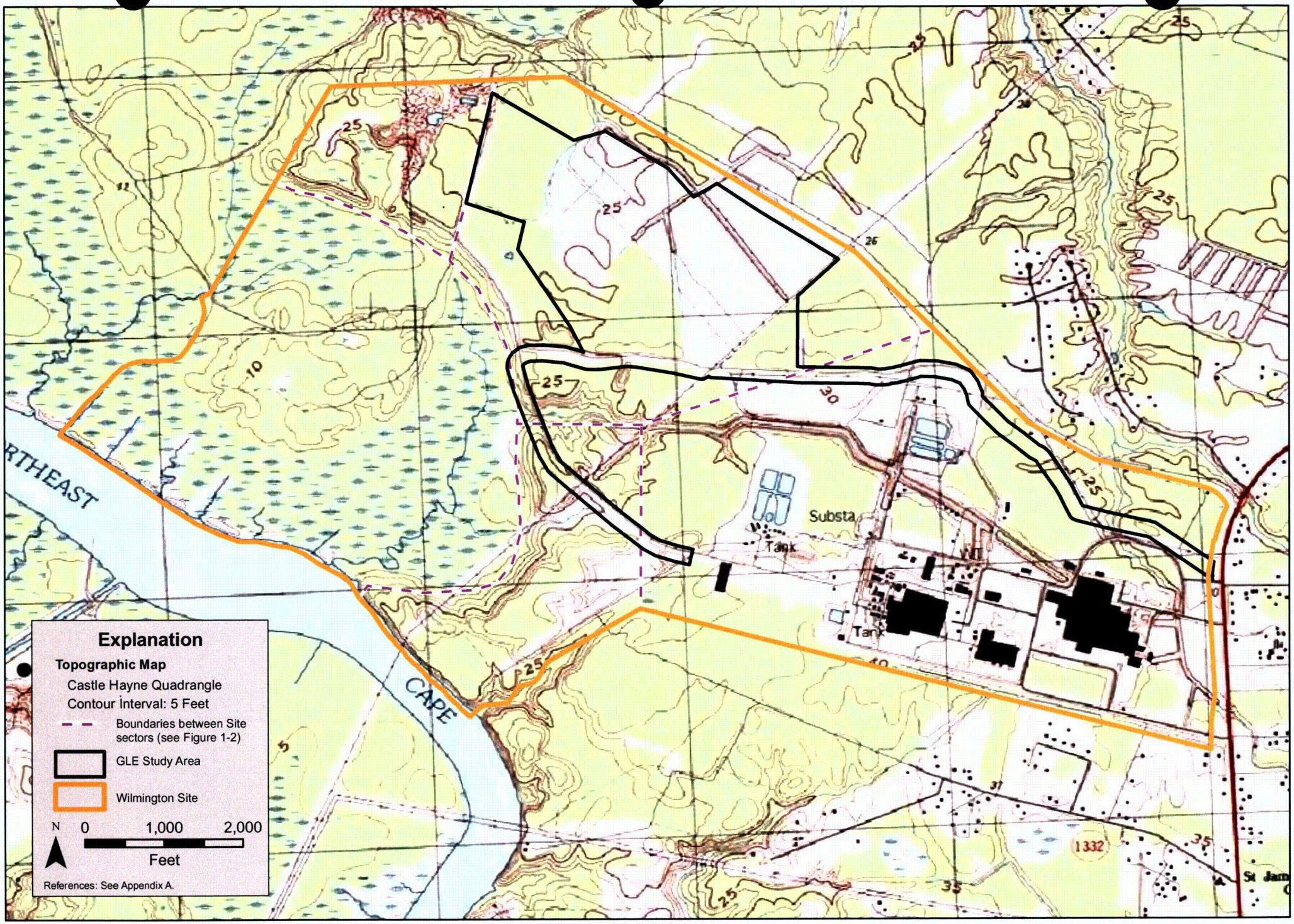


Figure 1-4. Topographic map of the Wilmington Site.

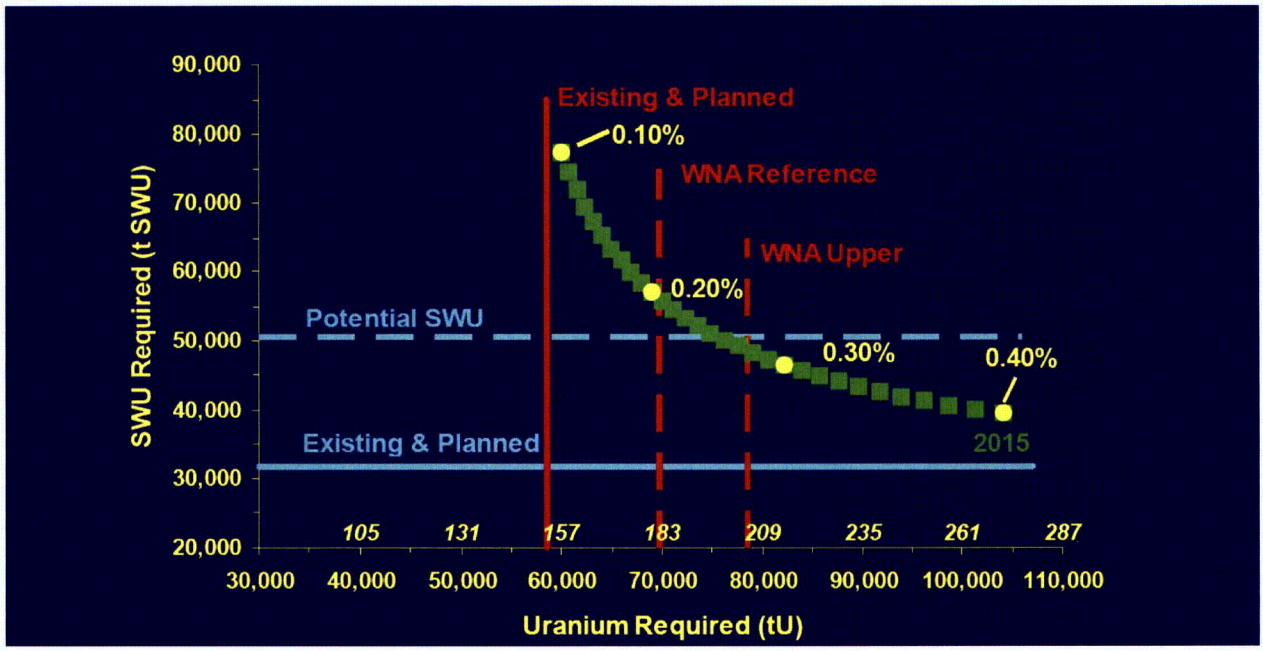


Figure 1-5. Assessment of western SWU and U requirements versus projected western uranium and enrichment supply capacity.*

Reference: Neff, 2006b.

* For varying feed tails assays in 2015.

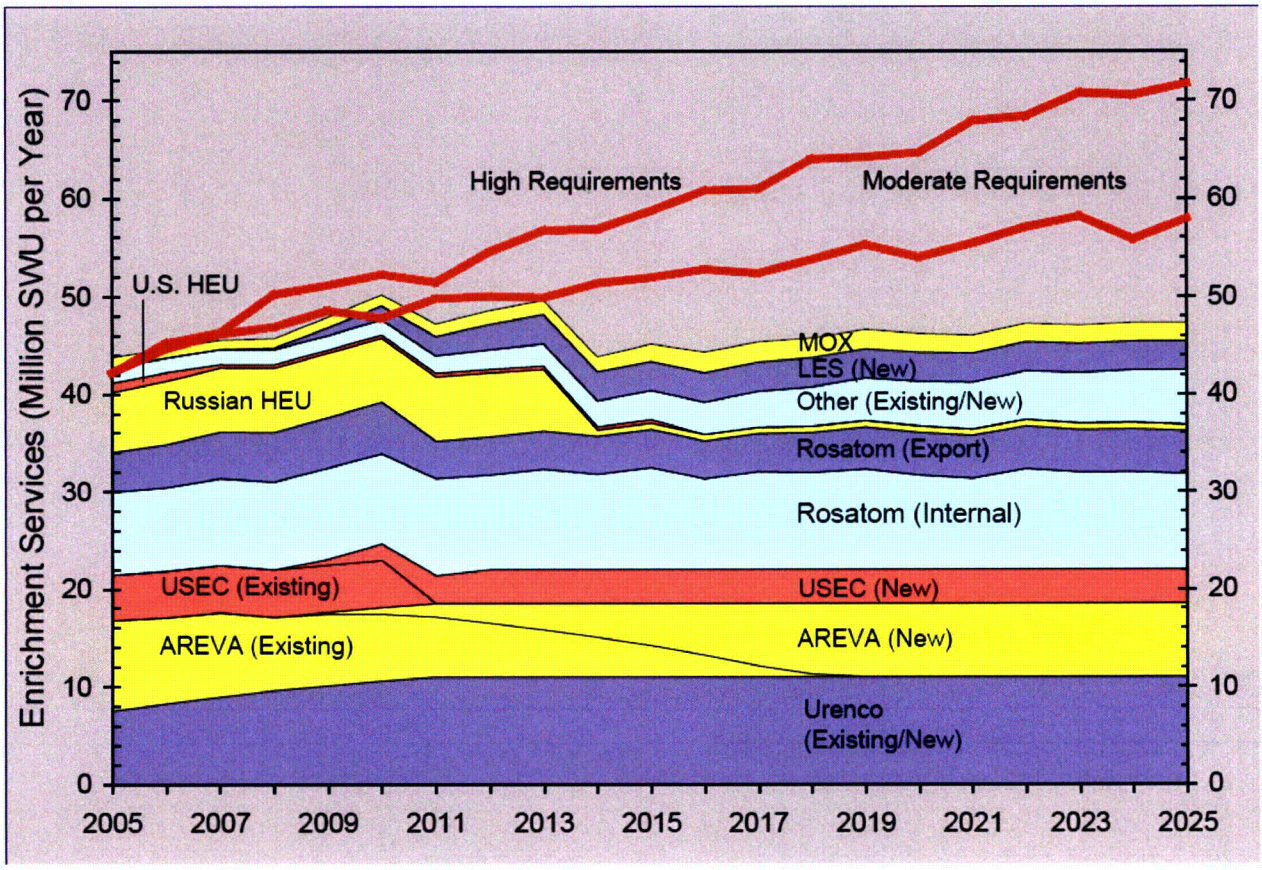


Figure 1-6. Comparison of world enrichment requirements and base supply (2005–2025).

Reference: Schwartz and Meade, 2006.

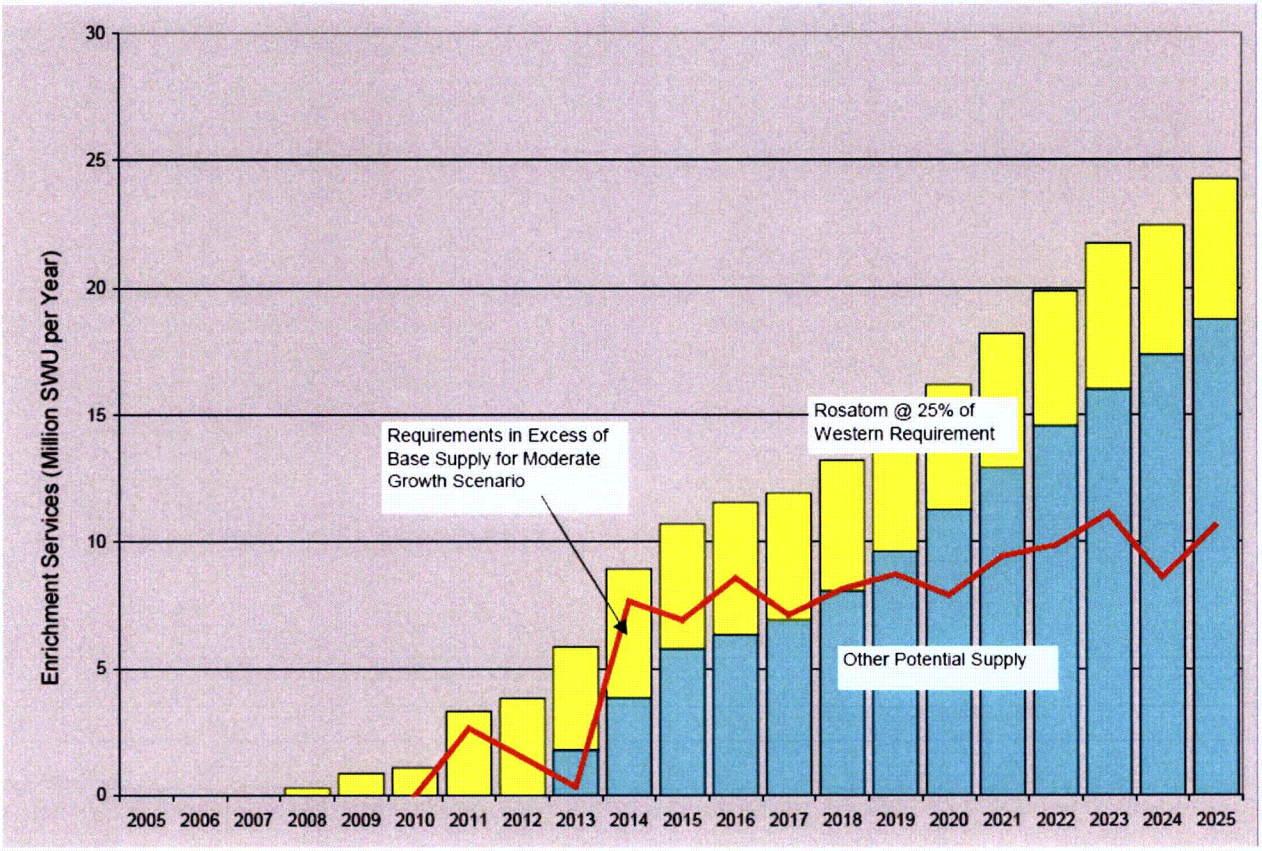


Figure 1-7. Evaluation of enriched uranium supply deficit under Moderate Nuclear Growth scenario.*

Reference: Schwartz and Meade, 2006.

* Assuming other potential sources of supply through 2025.

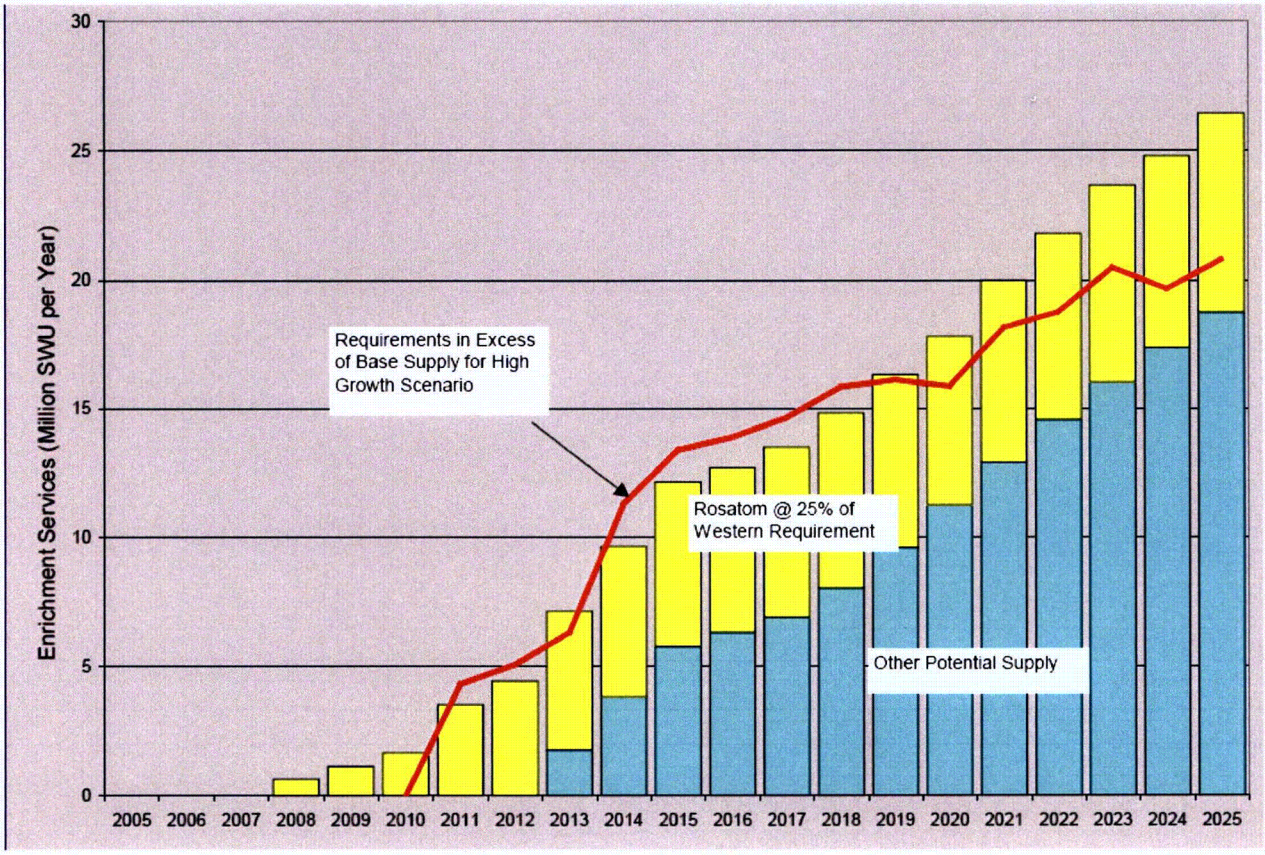


Figure 1-8. Evaluation of enriched uranium supply deficit under High Nuclear Growth scenario.*

Reference: Schwartz and Meade, 2006.

* Assuming other potential sources of supply through 2025.

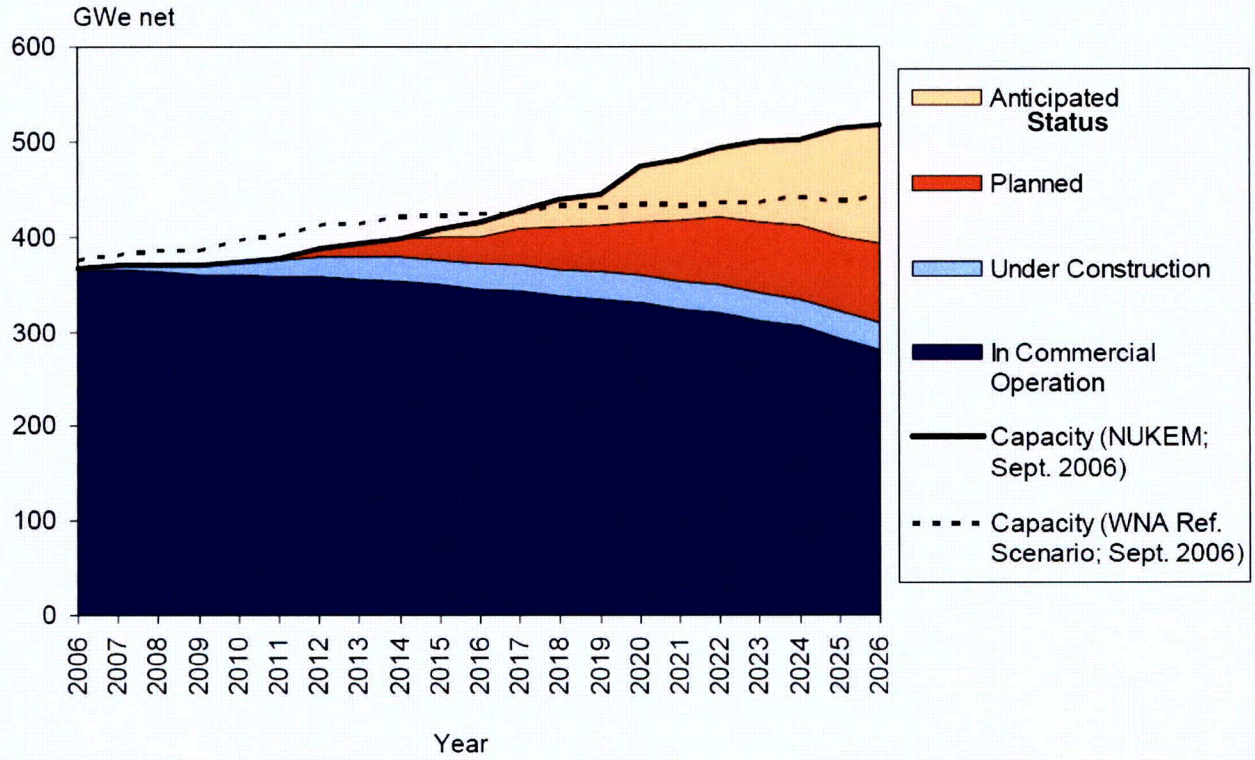


Figure 1-9. Forecast of world nuclear power plant capacity by status.

Reference: Lohrey, 2006.

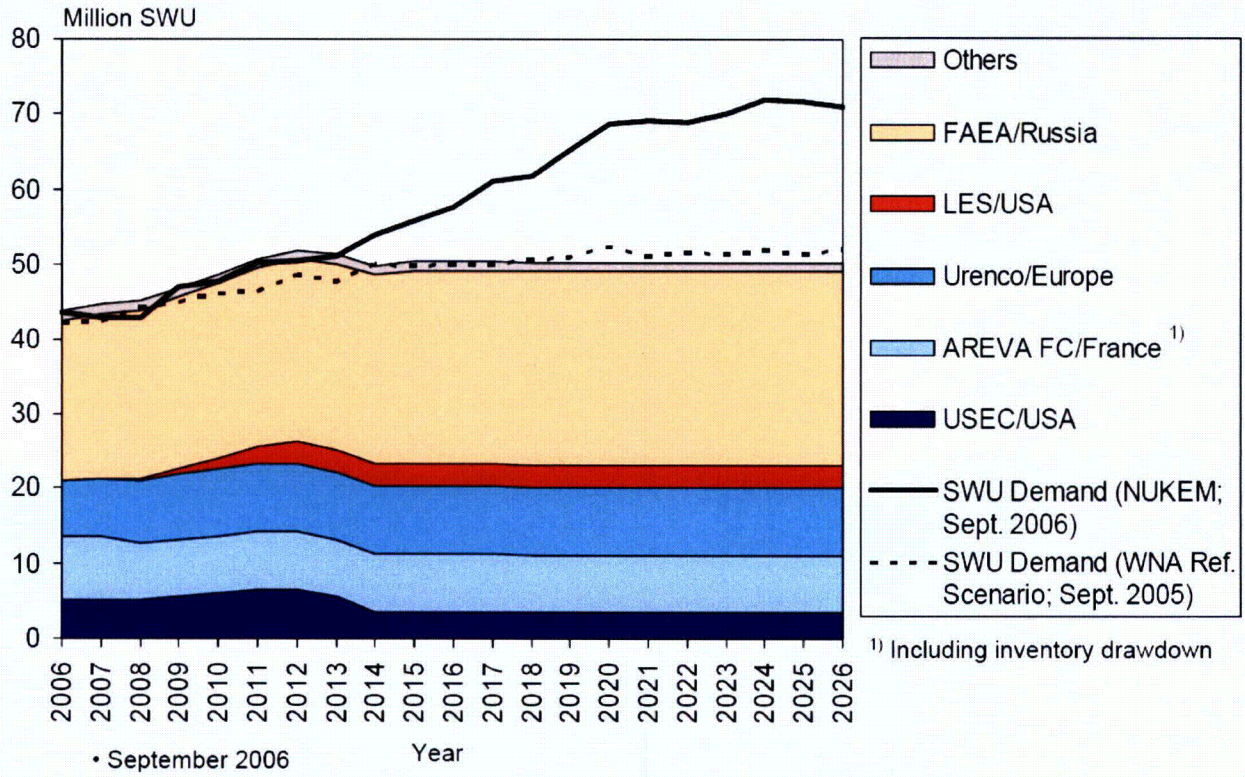


Figure 1-10. Forecast of world SWU capacity and reactor demand.*

Reference: Lohrey, 2006.

* Existing and planned SWU capacity.

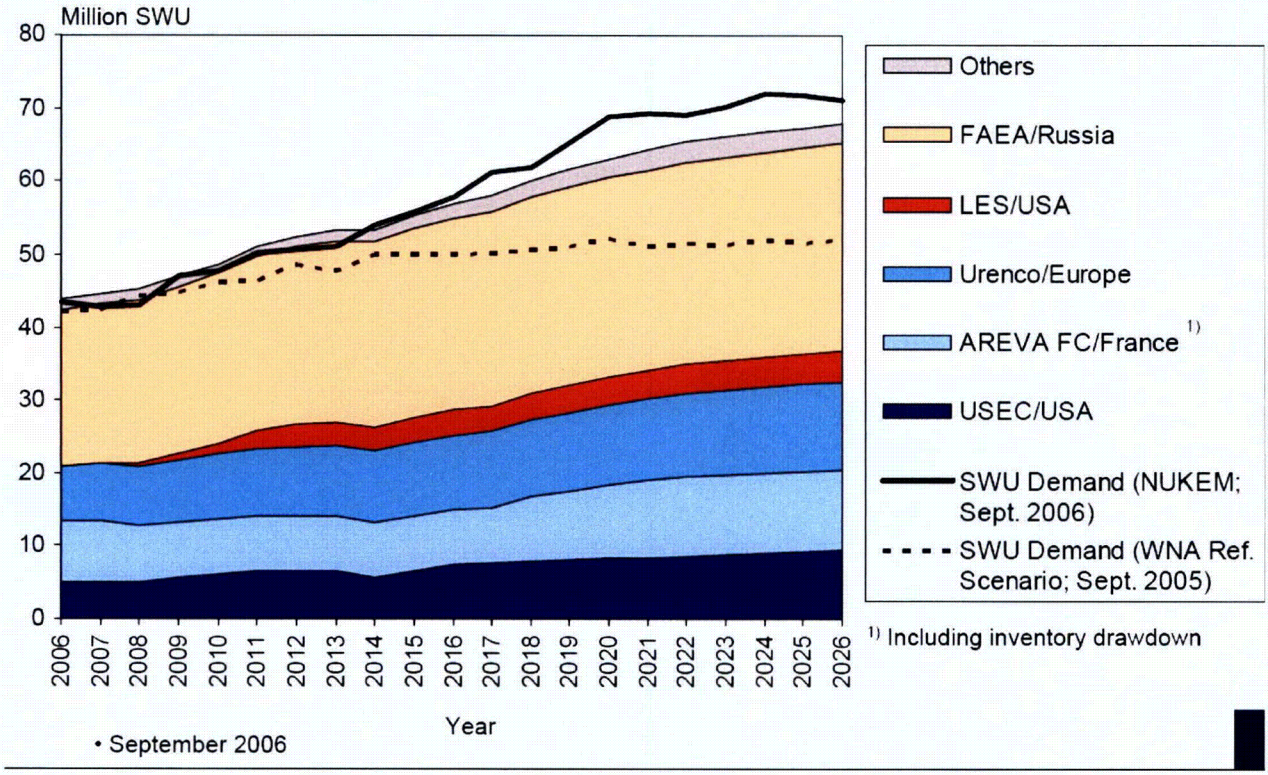


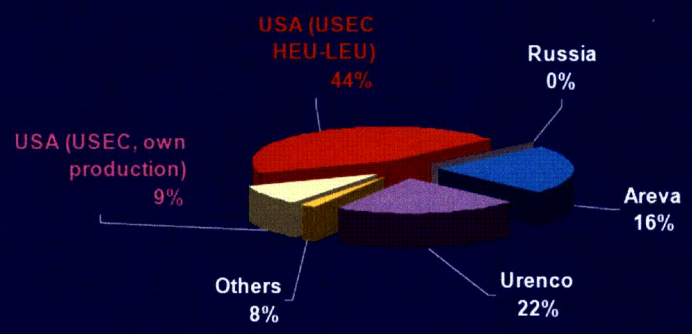
Figure 1-11. Forecast of world SWU capacity and reactor demand, including prospective SWU capacity.*

Reference: Lohrey, 2006.

* Existing, planned, and prospective SWU capacity.

Key players in the market:

- USEC – sole U.S. producer, resells Russian LEU from the HEU-LEU Agreement;
- Russia – sells only under the HEU-LEU Agreement, no commercial SWUs in the market;
- Areva – limited by antidumping and countervailing investigations;
- Urenco – construction of an enrichment facility in the US (LES);
- Others – low market share



Based on EIA "Uranium Marketing Annual Survey" (2003-2005)

Figure 1-12. Relative shares of U.S. uranium enrichment market participants in 2005.

Reference: Mikerin, 2006.

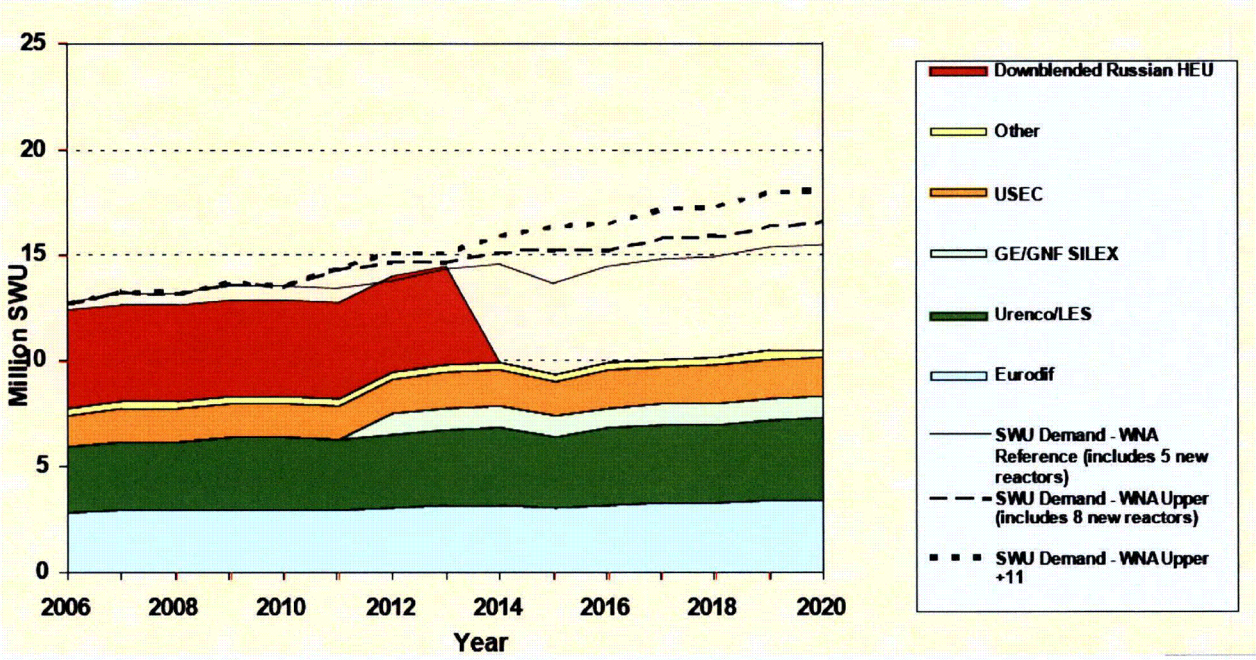


Figure 1-13. United States SWU demand and forecasted supplier share (2006–2026).

Reference: Cornell, 2006.

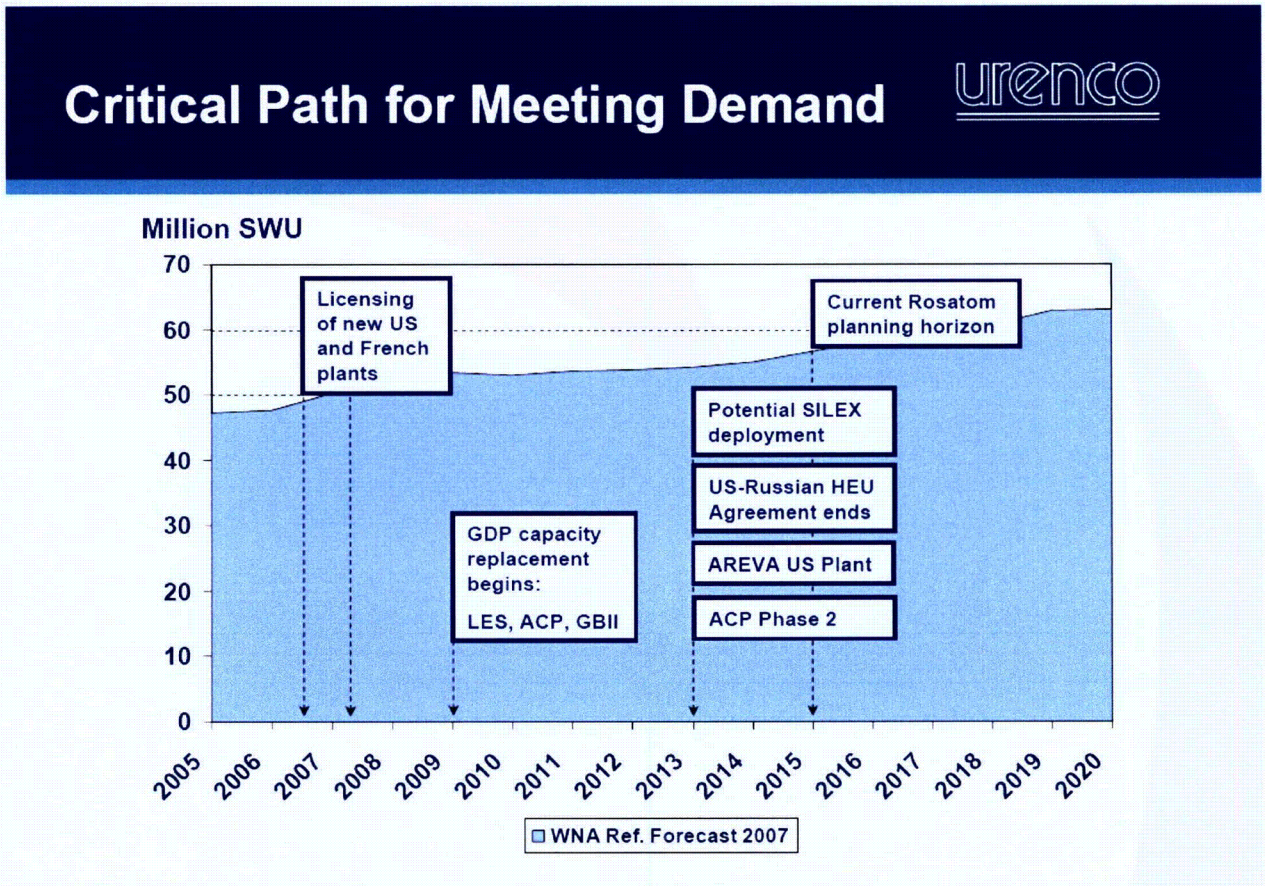


Figure 1-14. Critical path for meeting demand.*

Reference: Harding, 2007.

* From October 30, 2007, presentation at the IBC Conference on Emerging Nuclear Fuel Cycles.

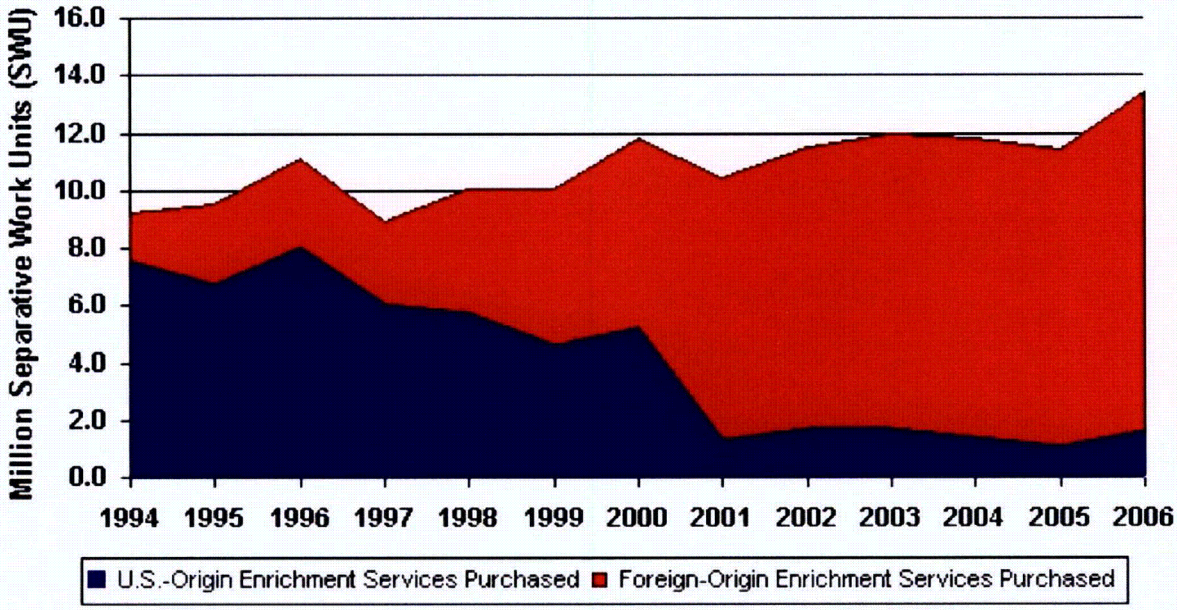


Figure 1-15. Uranium-enrichment services purchased by owners and operators of U.S. civilian nuclear power reactors (1994–2006).

Reference: EIA, 2007.