Environmental Report for the GLE Commercial Facility

Volume I

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PREPARED FOR:

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List of Acronyms

µCi	microcurie
µg	microgram
µg/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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GLE Environmental Report

Executive Summary

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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

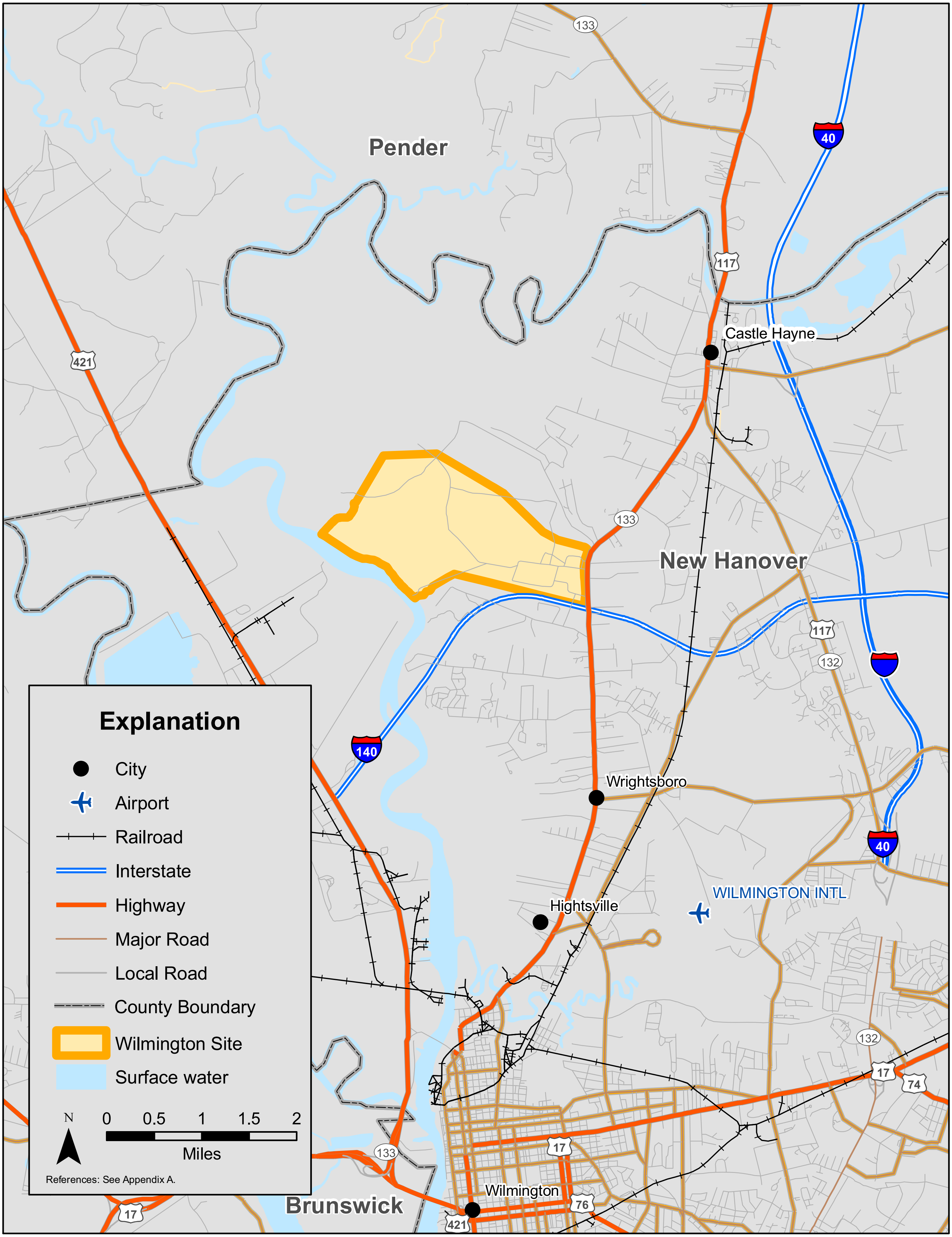

Figure ES-1. Wilmington Site location and vicinity.

GLE Environmental Report

Chapter 1 – Introduction

Revision 0

December 2008

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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**.

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)

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
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

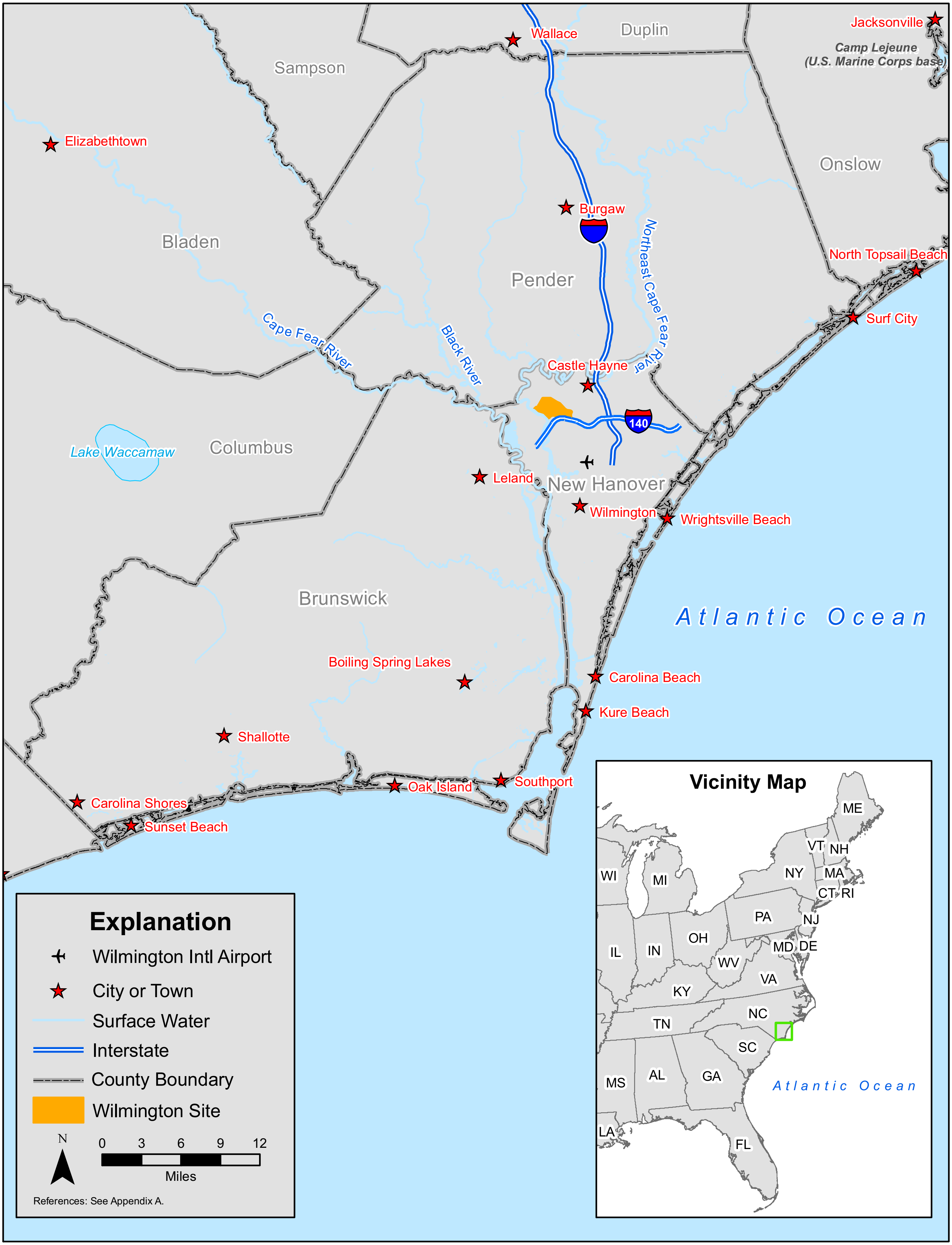

Figure 1-1. Wilmington Site location.

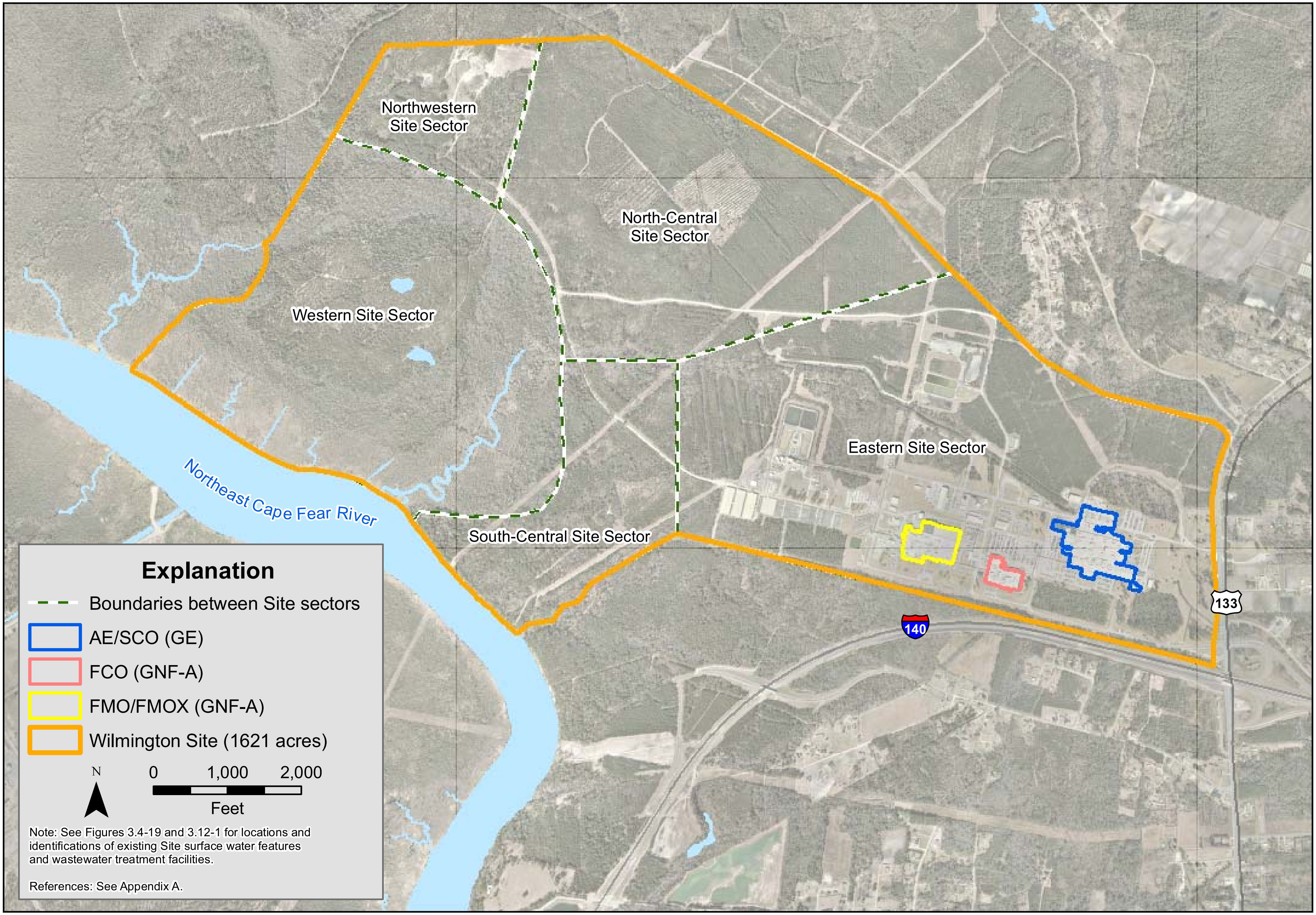

Figure 1-2. Wilmington Site sectors for reference in Environmental Report.

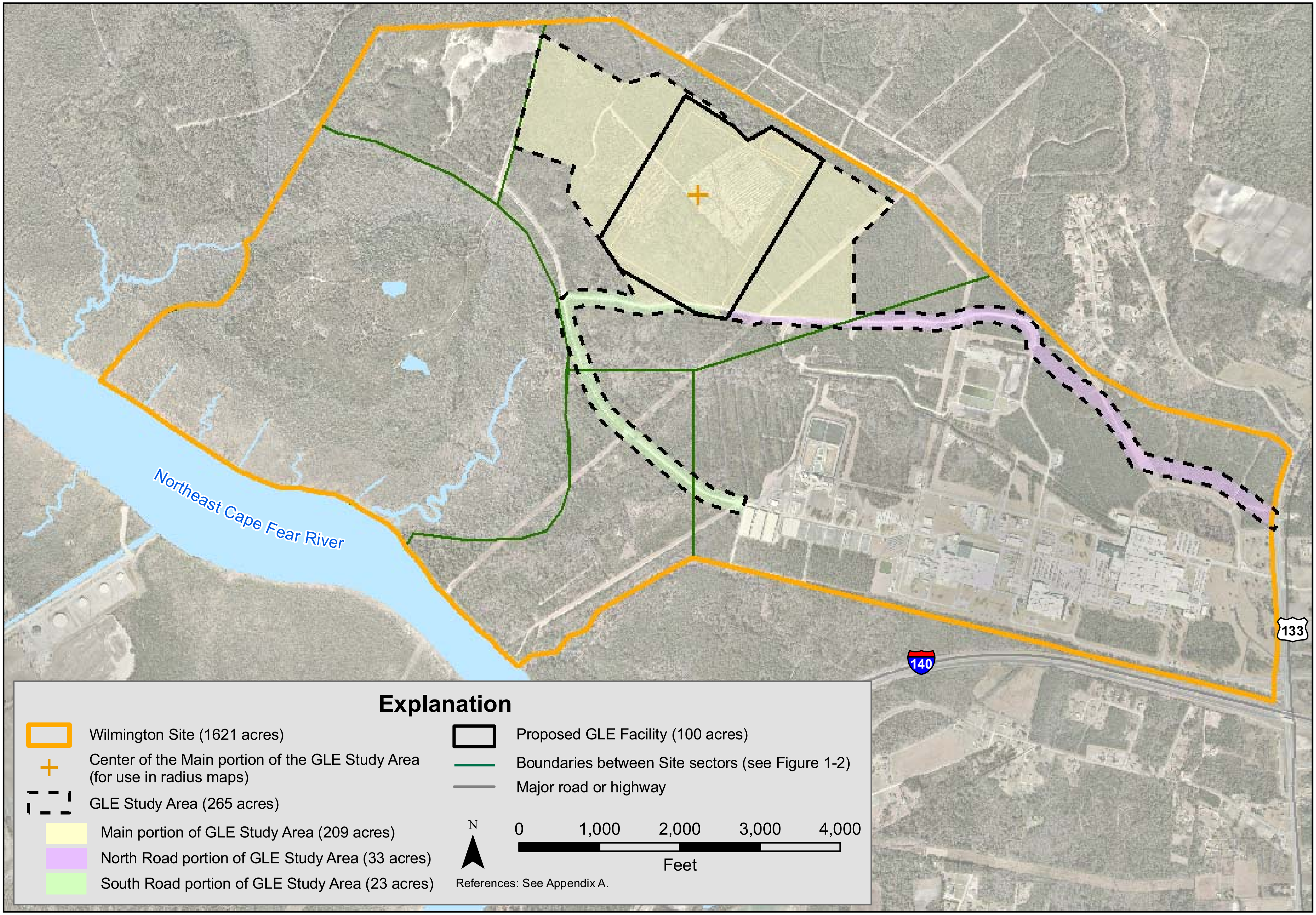

Figure 1-3. Location of the GLE Study Area and Proposed GLE Facility at the Wilmington Site.

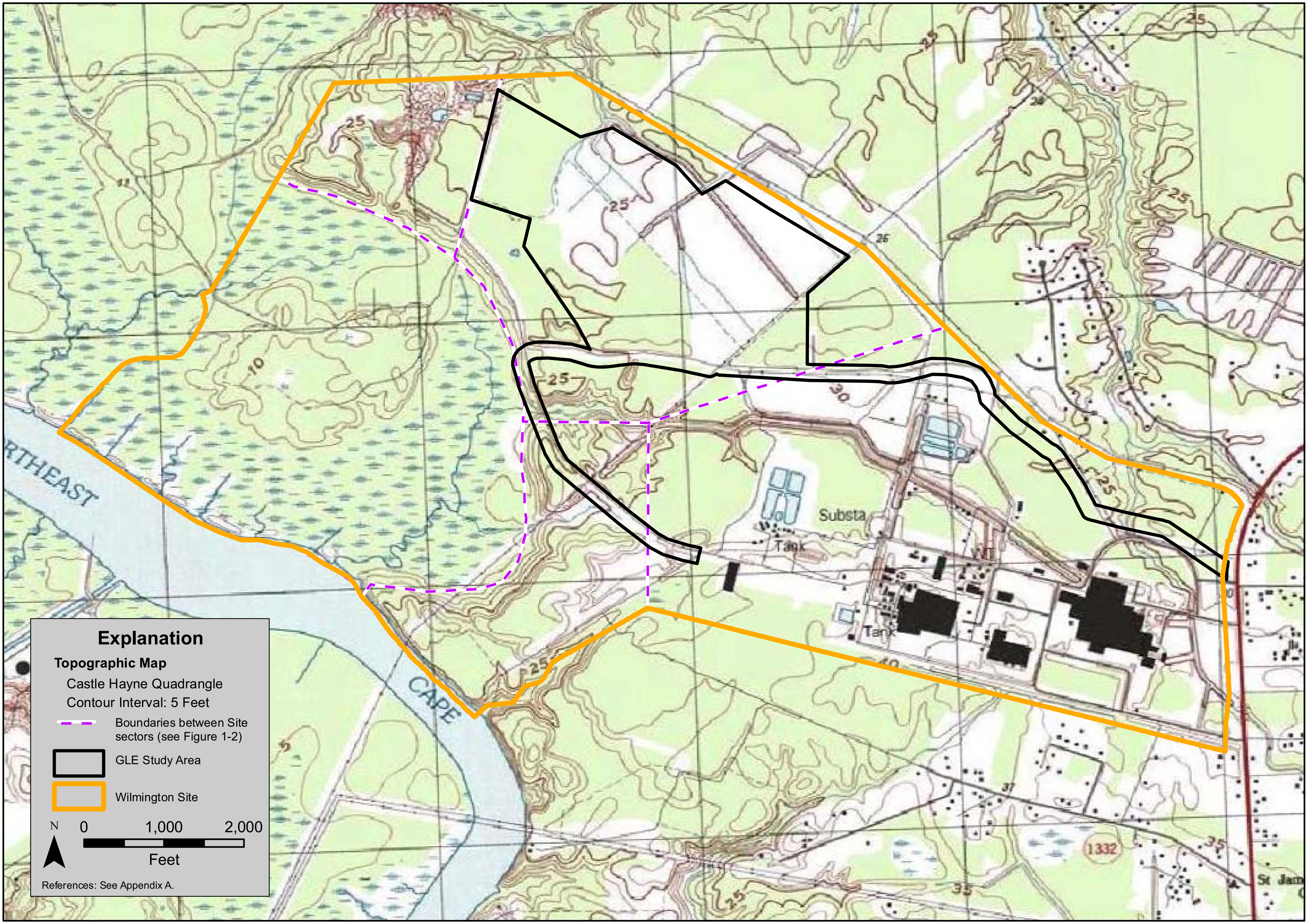

Figure 1-4. Topographic map of the Wilmington Site.

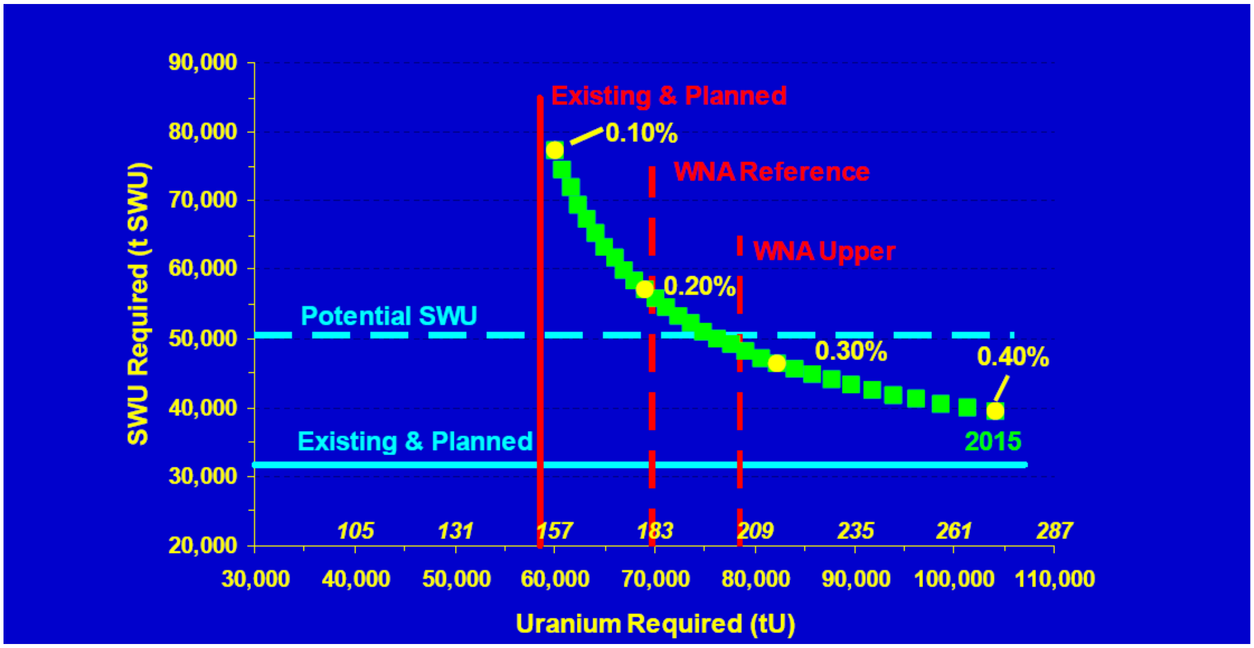

Figure 1-5. Assessment of western SWU and U requirements versus projected western uranium and enrichment supply capacity.*

Reference: Neff, 2006b.

* For varying feed tails assays in 2015.

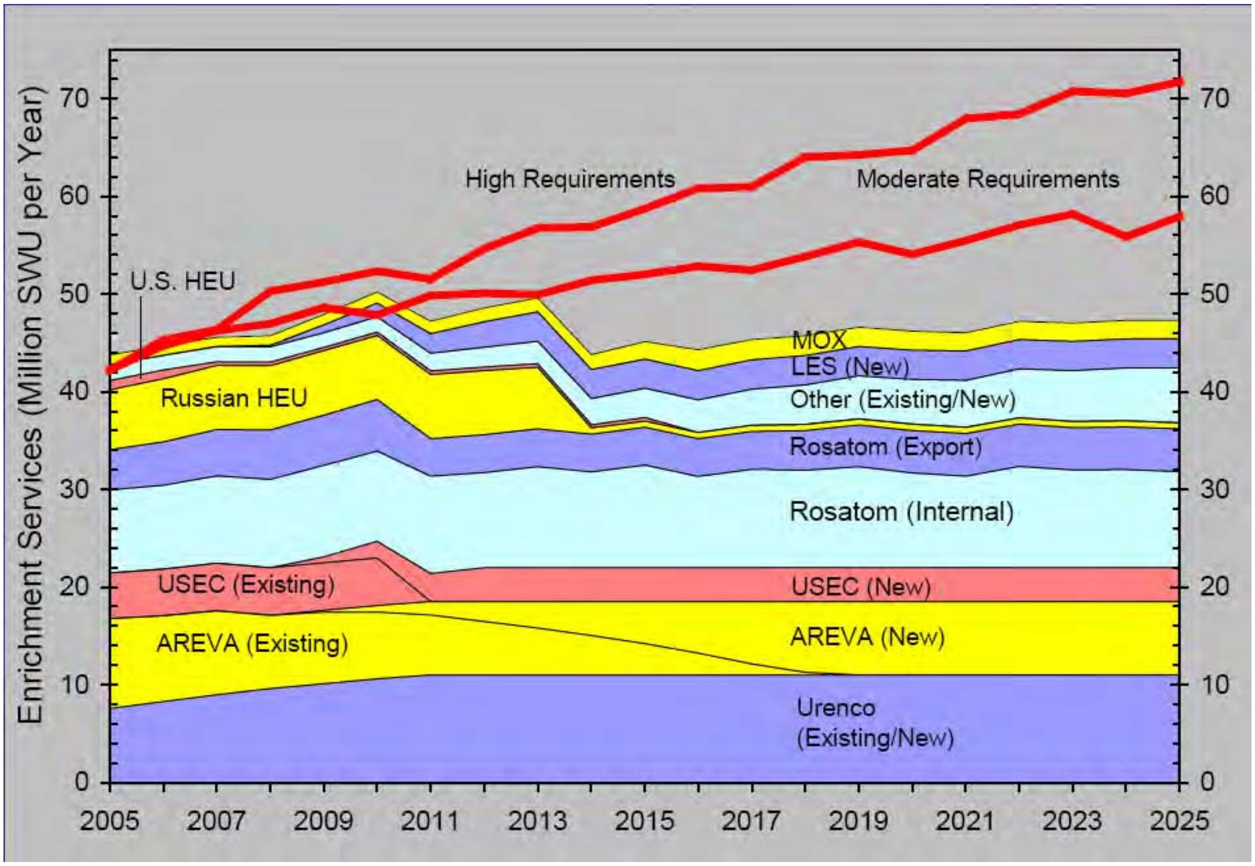

Figure 1-6. Comparison of world enrichment requirements and base supply (2005–2025).

Reference: Schwartz and Meade, 2006.

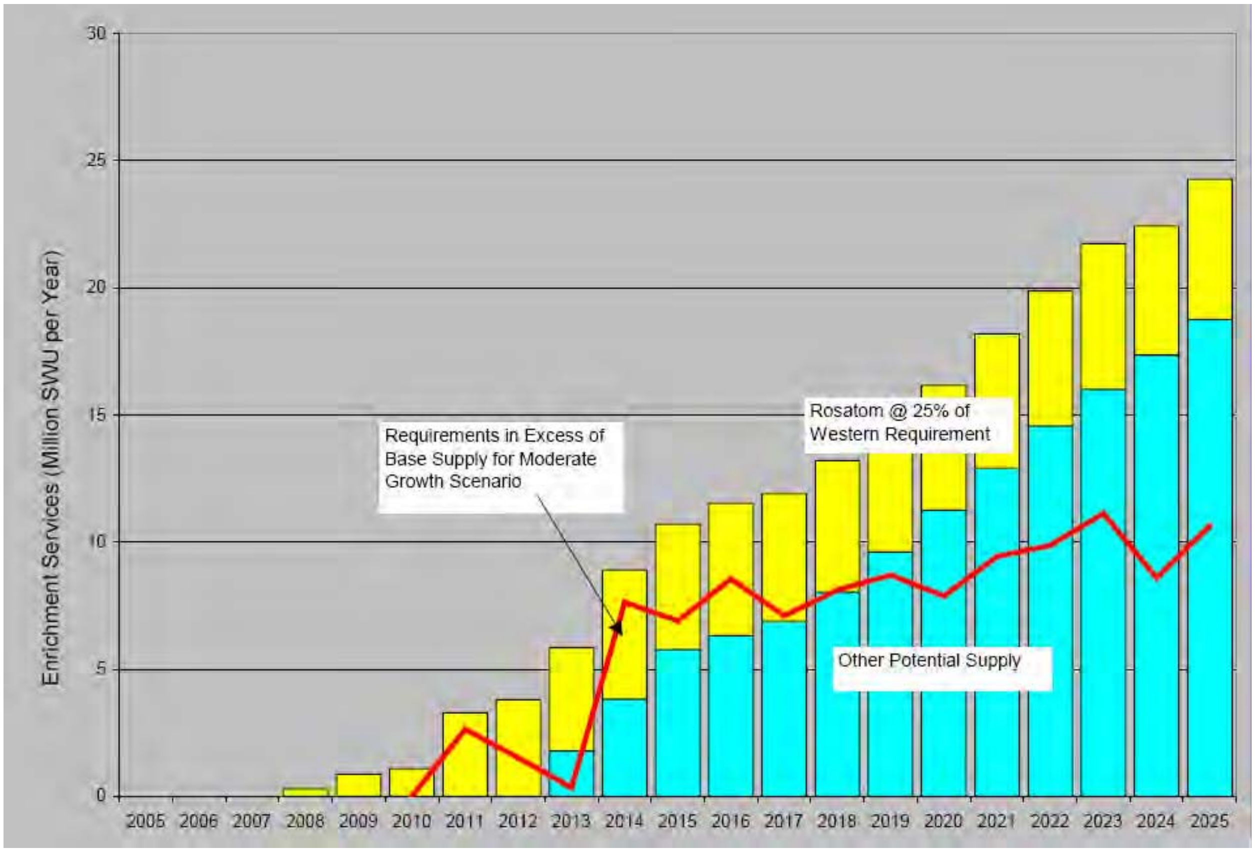

Figure 1-7. Evaluation of enriched uranium supply deficit under Moderate Nuclear Growth scenario.*

Reference: Schwartz and Meade, 2006.

* Assuming other potential sources of supply through 2025.

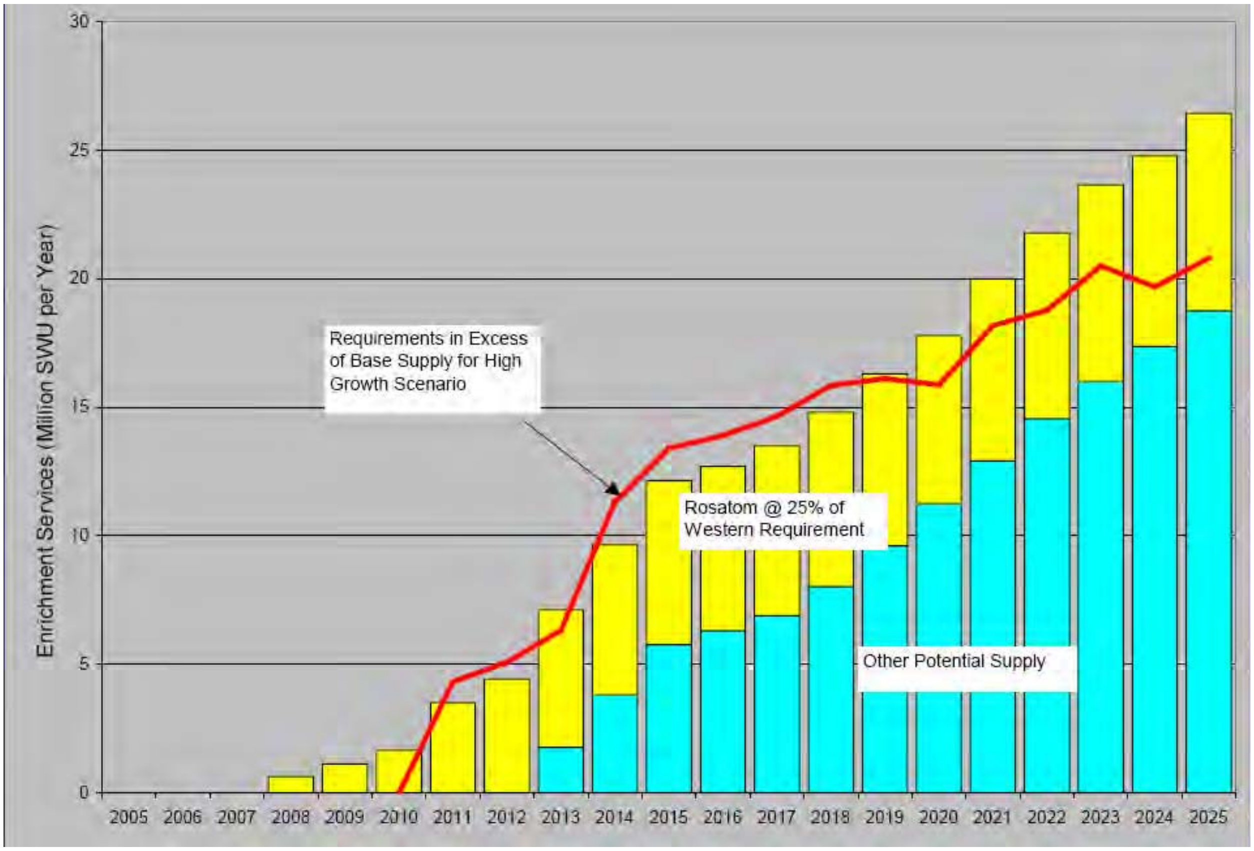

Figure 1-8. Evaluation of enriched uranium supply deficit under High Nuclear Growth scenario.*

Reference: Schwartz and Meade, 2006.

* Assuming other potential sources of supply through 2025.

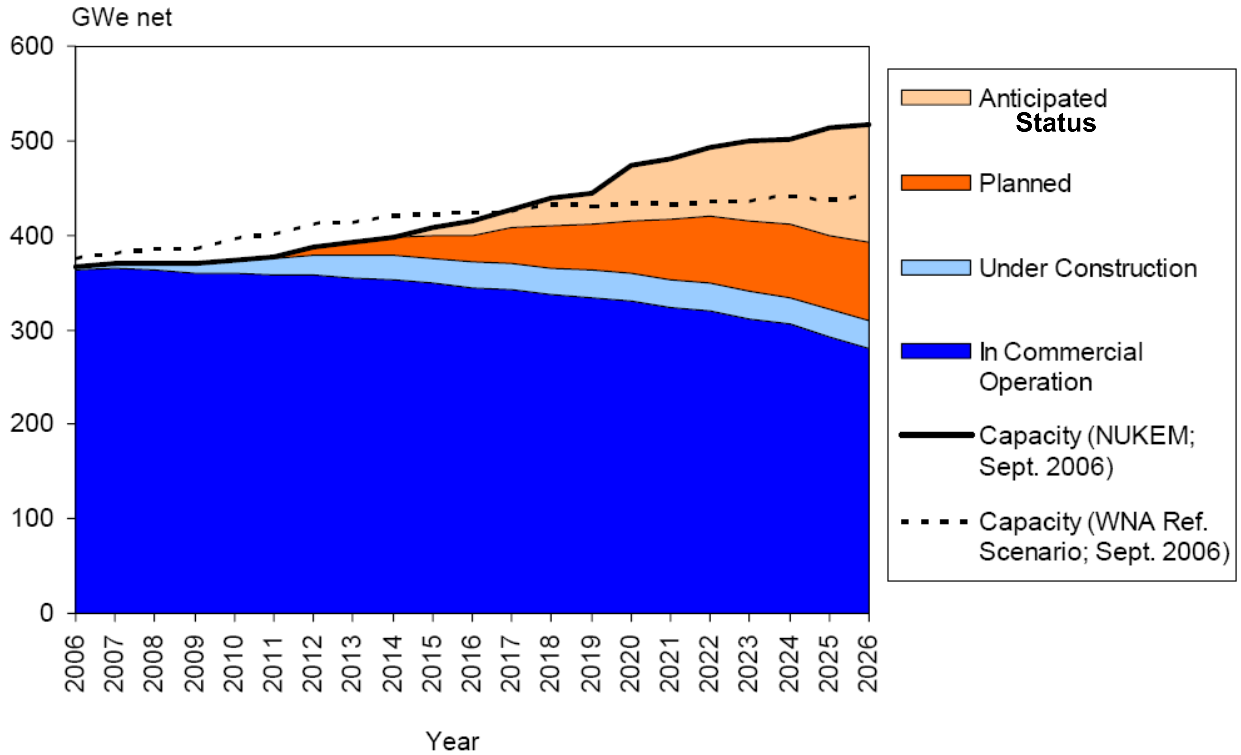

Figure 1-9. Forecast of world nuclear power plant capacity by status.

Reference: Lohrey, 2006.

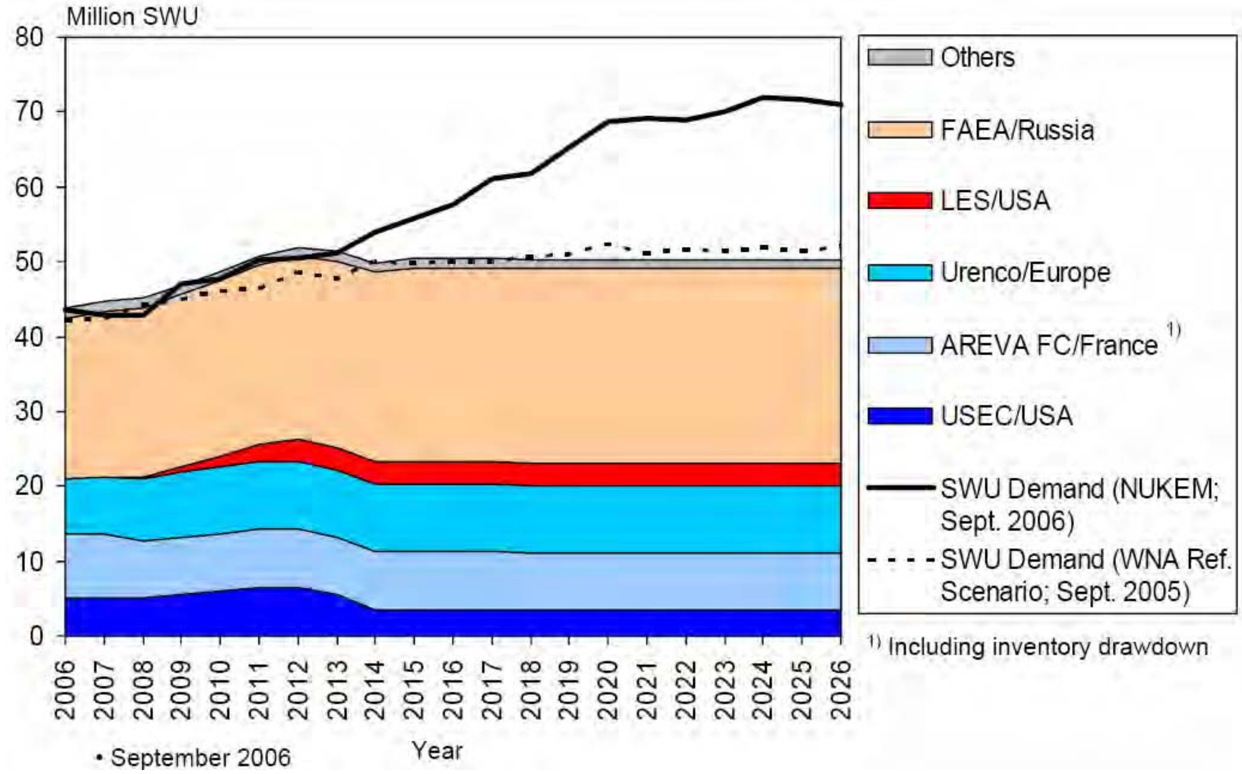

Figure 1-10. Forecast of world SWU capacity and reactor demand.*

Reference: Lohrey, 2006.

* Existing and planned SWU capacity.

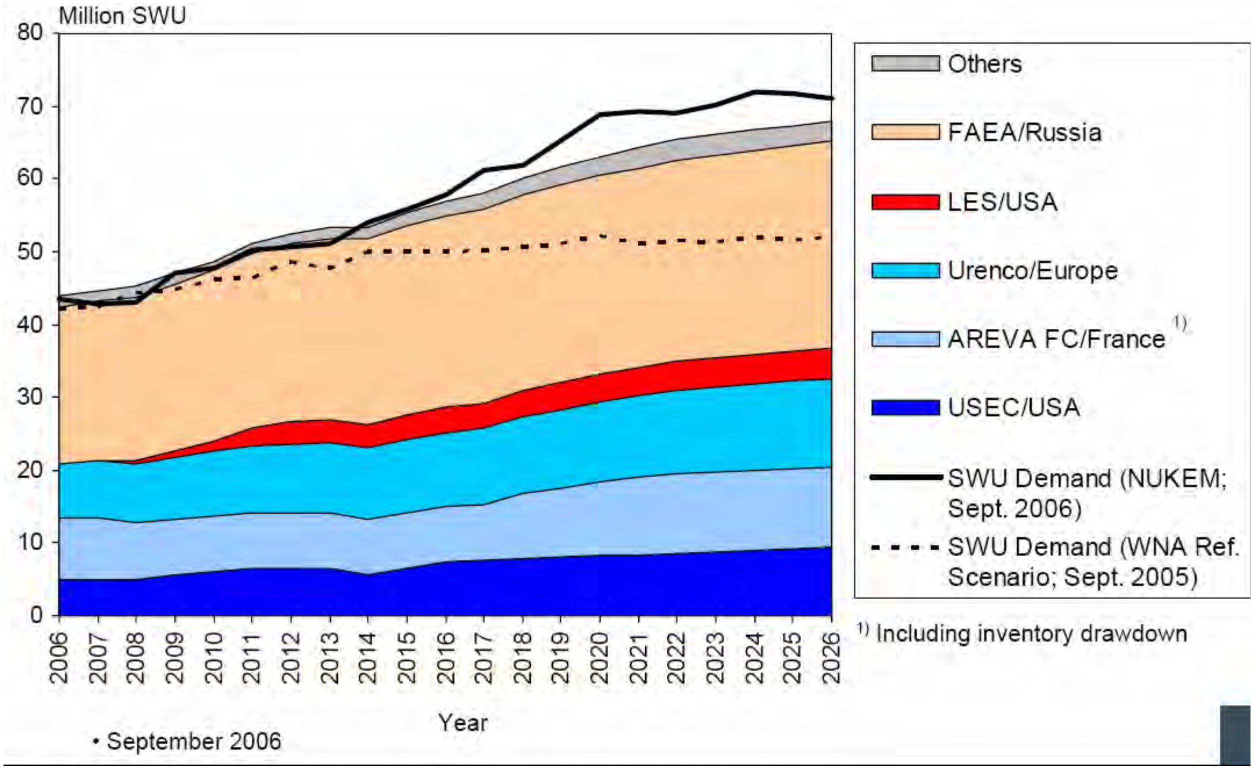

Figure 1-11. Forecast of world SWU capacity and reactor demand, including prospective SWU capacity.*

Reference: Lohrey, 2006.

* Existing, planned, and prospective SWU capacity.

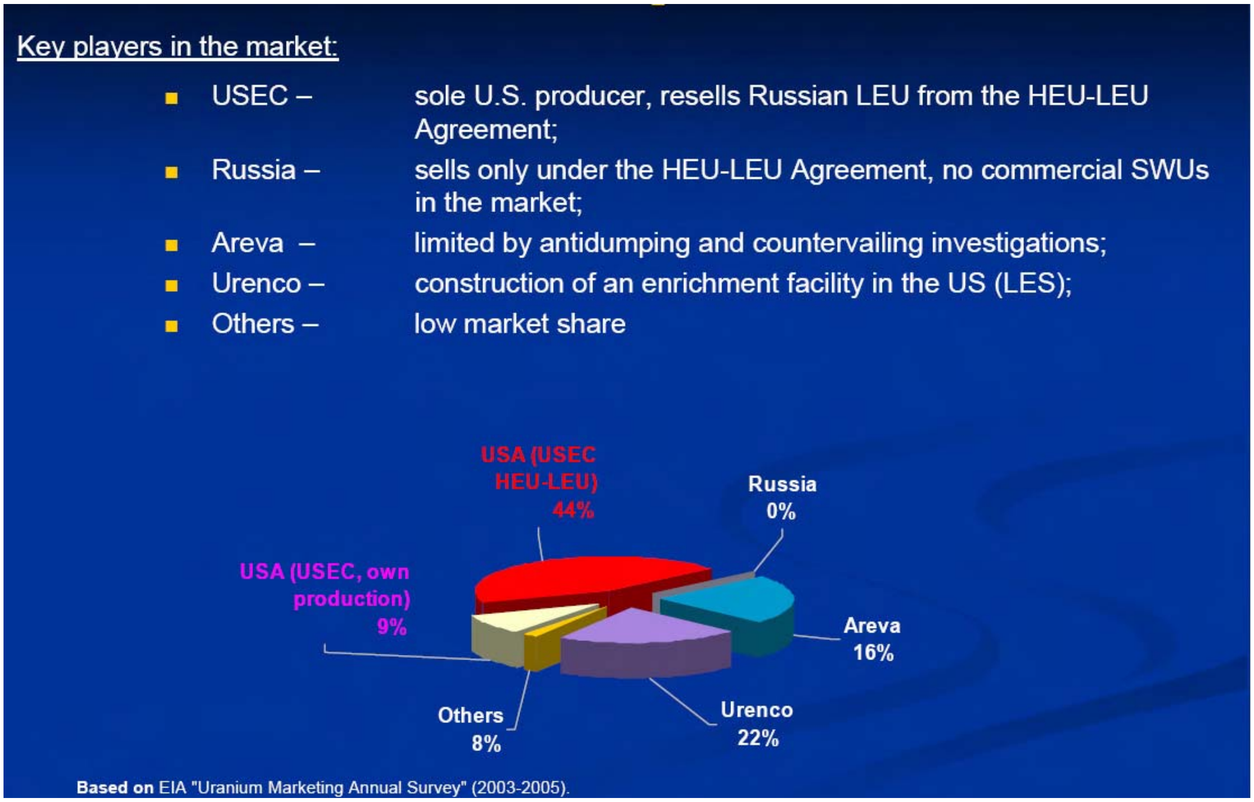

Figure 1-12. Relative shares of U.S. uranium enrichment market participants in 2005.

Reference: Mikerin, 2006.

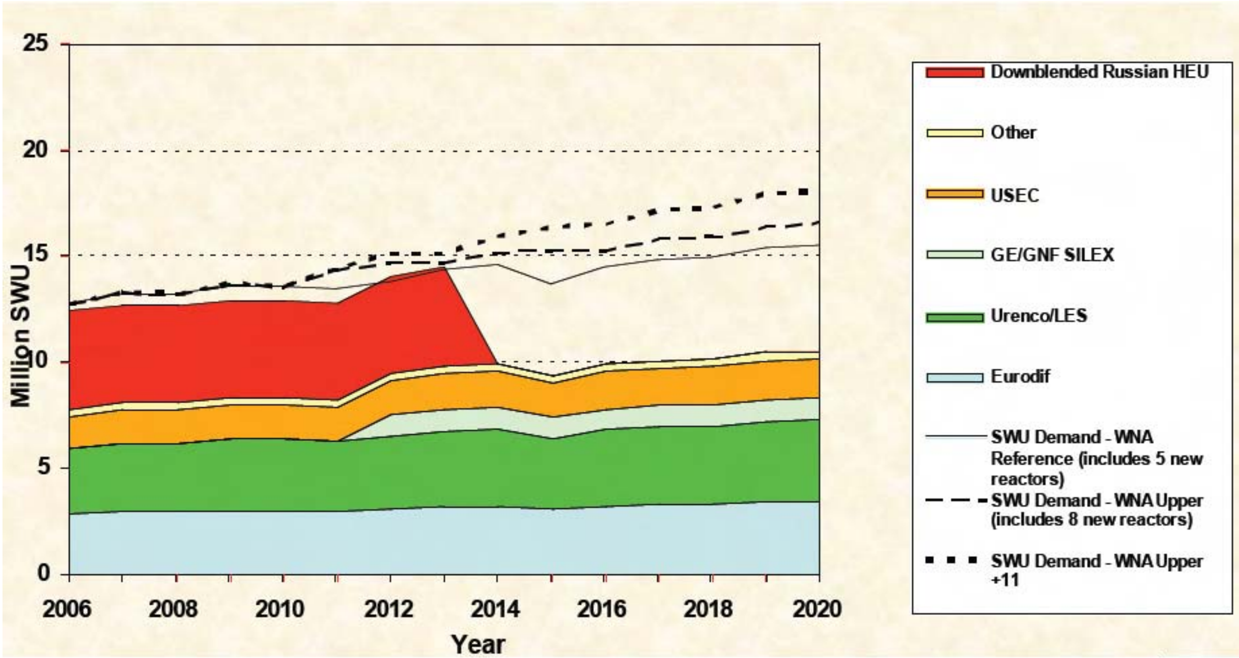

Figure 1-13. United States SWU demand and forecasted supplier share (2006–2026).

Reference: Cornell, 2006.

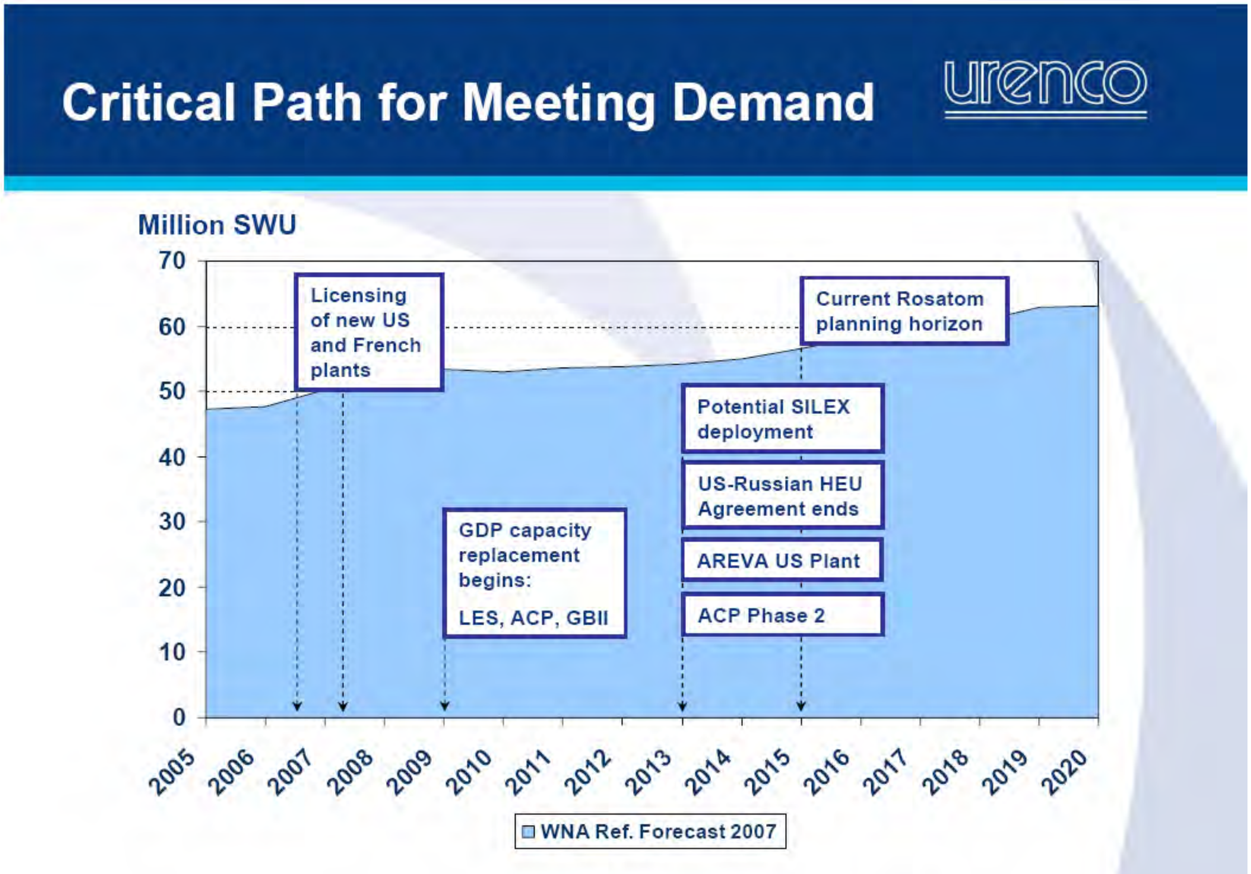

Figure 1-14. Critical path for meeting demand.*

Reference: Harding, 2007.

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

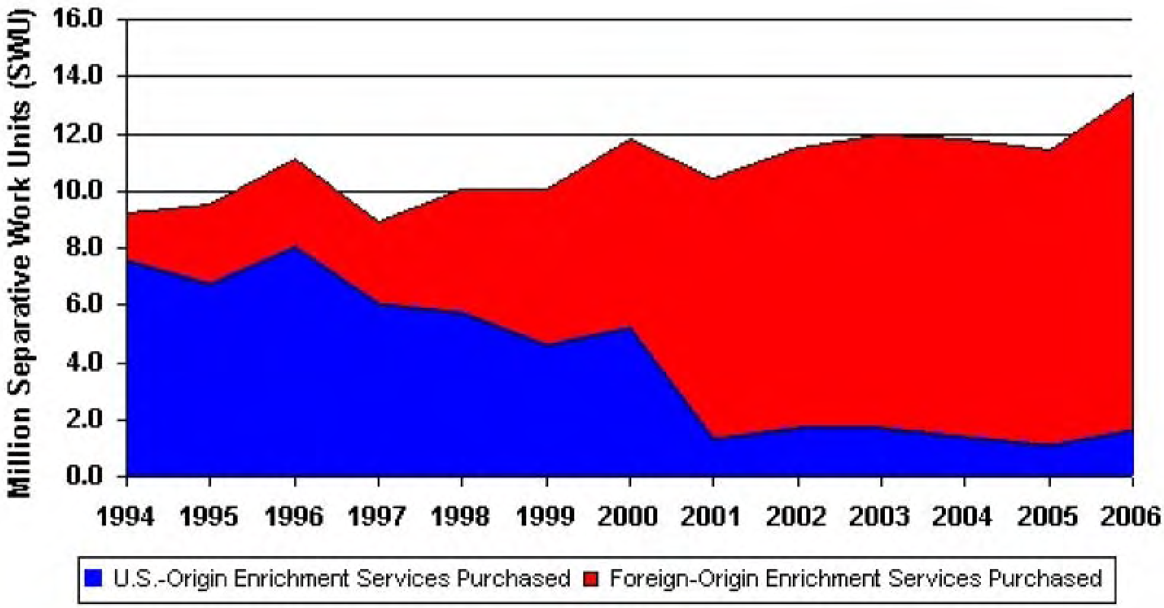

Figure 1-15. Uranium-enrichment services purchased by owners and operators of U.S. civilian nuclear power reactors (1994–2006).

Reference: EIA, 2007.

GLE Environmental Report

Chapter 2 – Alternatives

Revision 0

December 2008

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2. Alternatives

2.1 Description of the Alternatives

This section describes the alternatives discussed in this Environmental Report (Report), including those that were not considered to be reasonable and were therefore eliminated from further study. This section also includes a discussion of cumulative effects and a comparison of potential environmental impacts of the Proposed Action and the alternatives, including the No Action Alternative.

2.1.1 No Action Alternative

Under the No Action Alternative, the U.S. Nuclear Regulatory Commission (NRC) would not issue a license application to construct and operate the Proposed Action uranium-enrichment facility (henceforth referred to as the Proposed GLE Facility or the Facility), and the Proposed GLE Facility would not be built. 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 (NRC, 2006a). Therefore, the No Action Alternative would negatively impact the availability of additional reliable and economical domestic sources of enriched uranium supply and would result in a failure to meet the following needs:

- **The need for enriched uranium to fulfill nuclear electrical generation requirements.** At present, nuclear power plants supply approximately 20% of the nation’s electricity requirements (EIA, 2007b). 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). 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).
- **The need for domestic uranium-enrichment capacity for national energy security.** 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, furthering both United States energy security and Global Nuclear Energy Partnership (GNEP) objectives by providing domestic enrichment capacity and lessening U.S. dependence on foreign sources of enriched uranium. As of 2007, about 90% of U.S. demand is supplied by foreign sources (EIA, 2007b).
- **The need for advanced uranium-enrichment technology in the United States.** The U.S. Congress, 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 No Action Alternative would not result in any environmental impacts from building the Proposed GLE Facility at the Wilmington Site. Current levels and/or projections of land development, transportation, terrain, groundwater, and surface water availability and quality would remain the same. There would be no additional impacts to the ecology, floodplains, wetlands, historical and cultural resources, public and occupational health, waste management, environmental justice, and visual/scenic conditions. Under the No Action Alternative, the area would not benefit from the expected positive impacts of the Proposed Action on local employment, income, and tax revenues during the construction, manufacturing, operation, and decommissioning phases.

2.1.2 Proposed Action

GLE is the applicant for the license to construct and operate the Proposed Action uranium-enrichment facility (i.e., Proposed GLE Facility). As required by 10 Code of Federal Regulations (CFR) 51 (*Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions*), this Report is being submitted to the NRC by GE-Hitachi Global Laser Enrichment LLC (GLE) to support licensing of the Proposed GLE Facility. The corporate identities of the organizations sharing ownership of the Proposed Action are more fully described in Chapter 2 of the license application, *Organization and Administration*.

As described in **Chapter 1** of this Report (*Introduction*), Global Nuclear Fuel–Americas (GNF-A) signed an exclusive agreement with Australia's Silex Systems Limited to license the SILEX (Separation of Isotopes by Laser Excitation) technology and develop the company's next-generation low-enriched uranium (LEU) manufacturing process in the United States. 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.

This section provides a description of the Proposed Action, including a summary of pre-operational, operational, and post-operations activities; a summary of potential impacts and associated proposed monitoring; a description of existing Wilmington Site facilities; and a description of the Proposed Action facilities and operations, including a description of the Proposed Action process design and a description of materials use, storage, and disposal.

2.1.2.1 Description of the Proposed Action

As previously indicated in **Chapter 1** of this Report (*Introduction*), the Proposed Action is to construct and operate a uranium-enrichment facility within the North-Central Site Sector of the Wilmington Site (**Figure 1-3**), approximately 6 miles (9.6 kilometers [km]) north of Wilmington, NC, 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. Existing facilities at the Wilmington Site include the GNF-A nuclear Fuel Manufacturing Operation (FMO) facility; therefore, radioactive materials are already handled and stored at the Wilmington Site.

The Proposed Acton includes construction, start-up, and operation of process buildings of the Proposed GLE Facility. Facility construction and start-up is expected to require 7 years (i.e., 3 years to initial Separative Work Units [SWU] production, and 4 additional years to proceed to final SWU production capability). The Facility would be initially licensed for 40 years of operation and would subsequently receive a license renewal or be decommissioned. The following is a list of Proposed Action milestones:

- 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.

2.1.2.1.1 Pre-Operational (Construction) Activities

The Proposed GLE Facility would be built on land already owned by General Electric Company (GE) and would be consistent with the Wilmington Site's current I-2 (Heavy Industrial) zoning classification. An access road (henceforth referred to as the proposed North access road) to the Proposed GLE Facility from

N.C. Highway 133 (NC 133, also known as Castle Hayne Road and, previously, U.S. Highway 117) would be built across the northeast portion of the Eastern Site Sector using the existing on-site service road routes to the fullest extent practical (the proposed North access road would be constructed within the area shown on **Figure 1-3** as the North Road portion of GLE Study Area). For direct transport (i.e., avoiding public roads) between the Proposed GLE Facility and GNF-A's FMO facility, an existing on-site service road within the area shown on **Figure 1-3** as the South Road portion of the GLE Study Area (henceforth referred to as the proposed South access road) would be paved and the existing stream crossing along this road would be improved (see also **Section 4.1.4** of this Report, *Control of Impacts*).

Required permits and other regulatory approvals discussed in **Section 1.4** of this Report (*Applicable Regulatory Requirements, Permits, and Required Consultations*) would be obtained during pre-operational activities. The GLE Facility site would require the clearing of approximately 100 acres (40 hectares [ha]) of presently undeveloped, forested land in the North-Central Site Sector of the Wilmington Site. Structures built within this area would include the main GLE operations building, several administrative and other Facility-support buildings, a parking lot, and outdoor uranium hexafluoride (UF_6) storage pads.

To the east of the 100-acre (40-ha) Proposed GLE Facility and within the Main portion of the GLE Study Area (see **Figure 1-3**) would be the following additional structures that cumulatively would require approximately 13 additional acres (5 ha) to be cleared:

- Access driveways connecting the Proposed GLE Facility to the North Road portion of the GLE Study Area (see **Figure 1-3**); guard houses; a 300,000-gallon (1.1-million-liter) aboveground water-storage tank for fire protection; a sanitary wastewater lift station; and a process wastewater lift station
- An approximately 1-acre (0.4-ha) electric substation that would tie into existing high-voltage electrical power lines that already transect the Site through the transmission line corridor easement
- An 8-acre (3.2-ha) stormwater wet detention basin (as defined by the North Carolina Department of Environment and Natural Resources [NCDENR] in 2007) designed to capture and treat the runoff from the entire 100-acre (40-ha) Proposed GLE Facility and its supporting facilities for the purposes of removing water pollutants and attenuating peak runoff volumes. (See **Section 4.4.2** of this Report, *Surface Water Impacts*, for more details on how stormwater would be managed for the Proposed Action.)

Aboveground electrical utility lines would connect the Proposed GLE Facility to the proposed new electrical substation. Potable and process water supply lines would be run to the Proposed GLE Facility from the existing Wilmington Site water-supply infrastructure. Sanitary waste and process wastewater (including treated liquid radiological wastewater) would be routed from the Proposed GLE Facility via underground lines to the lift stations installed adjacent to and east of the 100-acre (40-ha) Proposed GLE Facility. The lift stations would deliver the respective wastewaters to the existing Wilmington Site sanitary wastewater treatment facility and final process lagoon treatment facility. The Proposed Action includes placement of new utility lines within existing utility corridors and/or clearings required for the new access roads and driveways, discussed previously. Should additional clearing be required between existing Wilmington Site facilities to accommodate these utility transmission lines, such actions would be conducted in compliance with applicable regulations, regulatory approvals, and current Wilmington Site Environmental Protection Instructions.

As discussed in **Section 2.1.2.3** and **Section 6.1** (*Radiological Monitoring*) of this Report, groundwater monitoring wells would be drilled and constructed within the GLE Study Area as part of pre-operational activities. Baseline sampling of groundwater quality would be conducted before the Proposed GLE

Facility becomes operational. Baseline soil sampling also would be conducted before the 100-acre (40-ha) Proposed GLE Facility is constructed. Results from the existing GNF-A Environmental Monitoring Program (GNF-A, 2007) would serve as pre-GLE baseline measurements for the qualities of air, surface water, sediment, treated sanitary wastewater effluent, and treated process wastewater effluent; therefore, additional activities for pre-operational assessments of baseline conditions would not be required for these media. During Facility construction, however, air monitoring would be conducted to verify whether dust-suppression practices are sufficiently effective, and stormwater monitoring would be conducted to verify whether measures prescribed in the Erosion and Sedimentation Control Plan are implemented as required by the National Pollutant Discharge Elimination System (NPDES) permit.

2.1.2.1.2 Operational Activities

Operations at the Proposed GLE Facility would involve shipping uranium feed materials primarily from the Honeywell facility in Metropolis, IL, and the Cameco facility in Port Hope, Ontario, Canada. Additionally, some uranium feed materials would be supplied from overseas sources and arrive at ports in Baltimore, MD, and Portsmouth, VA. Regardless of the point of origin, the feed material would arrive at the Proposed GLE Facility access road via trucks exiting U.S. Interstate Highway 140 (I-140). 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 uranium-235 (^{235}U) into a product stream enriched up to 8 wt. percent ^{235}U and a depleted UF_6 stream (UF_6 tails) containing approximately 0.25 wt. percent ^{235}U. The process is based on selective excitation by a laser light of UF_6 molecules that contain ^{235}U to separate ^{235}U from uranium-238 (^{238}U).

The initial target production capacity at design throughput is 6 million SWU per year. Some UF_6 product produced at the Proposed GLE Facility would be used on-site by the FMO facility. This material would be moved from the Proposed GLE Facility to the FMO facility by trucks using the existing on-site service road situated within the South Road portion of the GLE Study Area (see **Figure 1-3**). The remainder of the UF_6 product from Proposed GLE Facility operations would be trucked off-site to other fuel manufacturing facilities, such as the ones in Columbia, SC, and Richland, WA.

Depleted UF_6 tails from the Proposed GLE Facility operations would be trucked to one of the DOE's depleted UF_6-conversion facilities being developed on DOE sites at Portsmouth, OH, and Paducah, KY, by Uranium Disposition Services, LLC, 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 tails would be stored on-site at the Proposed GLE Facility. Low-level radioactive wastes (LLRW) generated by Proposed GLE Facility operations would be shipped to the Energy*Solutions* disposal facility in Clive, UT (see **Section 4.2.3.2** of this Report, *Transportation Modes, Routes, and Distances*).

2.1.2.1.3 Decontamination and Decommissioning

A Decommissioning Funding Plan (DFP) is included as part of the GLE license application in accordance with 10 CFR 70.25 (*Financial assurance and recordkeeping for decommissioning*). The DFP demonstrates financial capability to support decommissioning and closure activities. In accordance with 10 CFR 70.25(f)(2), financial assurances will be provided by GE through a parent company guarantee.

Before decommissioning activities begin, a Decommissioning Plan would be prepared and submitted to the NRC pursuant to 10 CFR 70.38 (*Expiration and Termination of Licenses and Decommissioning of Sites and Separate Buildings or Outdoor Areas*). The Decommissioning Plan would provide information concerning the Proposed GLE Facility, the types of items to be decontaminated, the disposition of facilities used for hazardous materials, the assumptions upon which the cost of decommissioning is derived, and an estimated schedule for decommissioning and closing the Facility. It is the intent of GLE to decommission and close the Proposed GLE Facility so as to reduce the level of radioactivity remaining in the Facility to residual levels acceptable for release of the Facility site for unrestricted use and for NRC license termination pursuant to 10 CFR 20.1401(*General provisions and scope*) and 10 CFR 20.1402 (*Radiological criteria for unrestricted use*).

Prior to decommissioning, an assessment of the radiological status of the Proposed GLE Facility would be made. Decommissioning and closure activities would include the cleaning and removal of radioactive and hazardous waste contamination that may be present on materials, equipment, and structures. Following is a list of general guidelines that would apply to the decommissioning and closure effort:

- A reasonable effort will be made to eliminate residual contamination.
- Radioactivity on equipment or surfaces shall not be covered by paint, plating, or other covering material unless contamination levels are below the limits specified in the Decommissioning Plan prior to applying the covering.
- The radioactivity on the interior surfaces of pipes, drain lines, and ductwork shall be determined by making measurements at all traps and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or ductwork.
- Surfaces of premises, equipment, or scrap material that are likely to be contaminated, but are of such size, construction, or location that the surfaces are inaccessible for purposes of measurement, shall be presumed to be contaminated in excess of the limits specified in the Decommissioning Plan.
- Classified material, components, and documents will be destroyed or disposed of in accordance with the GLE Security Program.
- Requirements for nuclear material control and accountability will be maintained during decommissioning in a manner similar to the programs in force during Proposed GLE Facility operation.
- Depleted UF_6 material (tails), if not sold or disposed of prior to decommissioning, will either be sold or will be converted to a stable, non-volatile uranium compound and disposed of in accordance with regulatory requirements.
- Radioactive wastes will be disposed of at licensed LLRW disposal sites.
- Hazardous wastes will be treated or disposed of in permitted hazardous waste facilities.
- Special requests may be made to the NRC to authorize the release of premises, equipment, or scrap material having surfaces contaminated in excess of the limits specified. This may include, but may not be limited to, special circumstances such as razing of buildings or transferring of premises or equipment to another organization or facility for reuse.
- Special requests may be made to the NRC to authorize special disposal methods pursuant to 10 CFR 20 (*Standards for Protection against Radiation*). Such methods may include, but are not limited to, on-site disposal of soil that may contain licensed material in acceptable levels.
- Radiation exposure limits shall be consistent with allowable limits specified in 10 CFR 20.
- Shipments of radioactive materials associated with decommissioning and closure shall conform to the regulations of Title 49 CFR for transporting hazardous materials.
- Prior to release for unrestricted use, a comprehensive radiation survey will establish that contamination levels and dose rates are within the limits approved at the time of decommissioning.

- The Proposed GLE Facility site will be closed in a manner that minimizes the need for further maintenance and controls to the extent necessary to protect human health and the environment.
- Independent reviews of the premises will be made to verify that hazardous waste and radioactive contamination have been removed to acceptable levels and that the premises meet regulatory release limits.

2.1.2.2 Impacts from Performing the Proposed Action and Mitigation Measures

Reasonably foreseeable environmental impacts and the extent of those impacts from the Proposed Action, potential mitigation measures, and restoration actions, if applicable, are described in detail in the resource-specific sections of **Chapter 4** of this Report (*Environmental Impacts*). **Table 2.1-1** presents a summary of the potential environmental impacts of the Proposed Action as compared against the No Action Alternative.

Potential mitigation measures of those impacts and associated potential restoration actions, if applicable, are further described in **Chapter 5** of this Report (*Mitigation Measures*). Mitigation measures are those actions or processes that would be implemented to avoid or minimize the magnitude of the impact of the Proposed Action on the affected environment; rectify (i.e., repair, rehabilitate, or restore) the affected environment; or compensate for the impact by providing substitute resources or environments (40 CFR 1508.20, *Mitigation*). **Chapter 5** also summarizes the proposed mitigation measures to reduce potential, adverse impacts (see **Chapter 4**, *Environmental Impacts*) that could result from the construction, operation, and decommissioning of the Proposed GLE Facility.

The extent of impacts considering all lifecycle phases from the Proposed Action is briefly summarized below by the environmental resource that could be impacted. The standard of significance (i.e., SMALL, MODERATE, LARGE) established by the NRC in NUREG-1748 (*Environmental Review Guidance for Licensing Actions Associated with NMSS [Nuclear Material Safety and Safeguards]*) *Programs)* was used to define the extent of impacts from the Proposed Action (see also **Section 2.3**). Overall, adverse impacts from the Proposed Action are anticipated to be SMALL. Implementation of mitigation measures will further reduce the severity of these impacts.

- Land Use – SMALL impacts
- Transportation – SMALL to MODERATE impacts
- Soils and Geology
  - Site soils – SMALL impacts
  - Geology – SMALL impacts
- Water Resources
  - Groundwater – SMALL impacts
  - Surface waters – SMALL impacts
  - Floodplains – SMALL impacts
  - Wetlands – SMALL impacts
  - Water use – SMALL impacts
- Ecology – SMALL to MODERATE impacts
- Air Quality – SMALL impacts
- Noise – SMALL to MODERATE impacts
- Historical and Cultural Resources – SMALL impacts

- Visual/Scenic – SMALL impacts
- Socioeconomics – SMALL impacts
- Environmental Justice – SMALL impacts
- Public and Occupational Health – SMALL impacts
- Waste Management – SMALL to MODERATE impacts.

2.1.2.3 Proposed Monitoring

In accordance with the Radiation Protection regulations in 10 CFR 20, the NRC requires that licensees perform the measurements and monitoring necessary to demonstrate compliance with these regulations and to demonstrate that the amount of radioactive material present in effluent from the Facility has been kept As Low As Reasonably Achievable (ALARA). In addition, pursuant to 10 CFR 70.59 (*Effluent monitoring reporting requirements*), the NRC requires that licensees submit semiannual reports specifying the quantities of the principal radionuclides released to unrestricted areas and other information needed to estimate the annual radiation dose to the public from effluent discharges. The NRC has also issued Regulatory Guide 4.15, *Quality Assurance for Radiological Monitoring Programs (Normal Operations)—Effluent Streams and the Environment* (NRC, 1979) and Regulatory Guide 4.16, *Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluent from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants* (NRC, 1985), which reiterate that concentrations of hazardous materials in effluent must be controlled and that licensees must adhere to the ALARA principal such that there is no undue risk to the public health and safety at or beyond the site boundary.

Chapter 6 of this Report (*Environmental Measurements and Monitoring Programs*) describes environmental baseline measurements and subsequent monitoring as applicable to site preparation and construction, operation, and decommissioning of the Proposed GLE Facility. See **Table 6-1** for a summary of the GLE Environmental Monitoring Program. Since the Proposed GLE Facility would be located on the Wilmington Site, the Environmental Monitoring Program was developed considering past experience and data. Where applicable, the existing GNF-A Environmental Monitoring Program (GNF-A, 2007) would be expanded to include monitoring required for the Proposed Action. This Expanded Monitoring Program would be implemented by the GNF-A and GLE Environment, Health, and Safety (EHS) Functions. As discussed in **Chapter 6** of this Report (*Environmental Measurement and Monitoring Programs*) and summarized in **Table 6-1**, in addition to locations currently monitored by GNF-A, sampling locations specific for the Proposed Action have been established to monitor for the following:

- Direct radiation (see **Figure 6-1**)
- Air quality (see **Figure 6-1**)
  - Main GLE operations building stack
  - Proposed GLE Facility [redacted]
  - Ambient (background) conditions
- Groundwater (see **Figure 6-2**)
- Soil (see **Figure 6-3**).

Security-Related Information Withheld Under 10 CFR 2.390

In addition, stormwater runoff from the UF_6 storage areas would be routed to a holding pond for monitoring before the stormwater is released to the Proposed GLE Facility stormwater wet detention basin. Sampling locations in addition to those currently monitored by GNF-A are not required for appropriate monitoring of surface water, sediment, treated sanitary wastewater effluent, and treated process wastewater effluent.

As discussed in **Section 2.1.2.1.1** and **Section 6.1** (*Radiological Monitoring*) of this Report, baseline sampling of soil and groundwater quality would be conducted before the Proposed GLE Facility becomes operational. Results from the existing GNF-A Environmental Monitoring Program (GNF-A, 2007) would serve as pre-GLE baseline measurements for the qualities of air, surface water, sediment, treated sanitary wastewater effluent, and treated process wastewater effluent; therefore, additional activities for pre-operational assessments of baseline conditions would not be required for these media. During Facility construction, however, air monitoring would be conducted to verify whether dust-suppression practices are sufficiently effective, and stormwater monitoring would be conducted to verify whether measures prescribed in the Erosion and Sedimentation Control Plan are implemented as required by the NPDES permit.

2.1.2.4 Site and Facility Information

This section presents a description of existing Wilmington Site facilities, as well as a description of the Proposed Action facilities and operations, including a description of the Proposed Action process design and a description of materials use, storage, and disposal.

2.1.2.4.1 Existing Wilmington Site Facilities

The existing Wilmington Site, the area selected for the Proposed GLE Facility, is situated on a 1621-acre (656-ha) tract of land located west of NC 133 (Castle Hayne Road). 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 approximately 6 miles (9.6 km) north of the city of Wilmington in New Hanover County, NC. **Figures ES-1 and 1-1** show the location of the Site in relation to nearby cities, towns, landmarks, highways, and rivers and other waterbodies.

As shown on **Figure 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 I-140, and directly south of the bypass are residentially developed properties.

An additional 24-acres (10 ha) east of NC 133 (Castle Hayne Road) also are owned by GE and are 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 FMO facility and the GE Aircraft Engines and Services Components Operation (AE/SCO) facility. **Figure 1-2** shows the locations of these facilities on an aerial photograph of the Wilmington Site. 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 Operations Expansion (FMOX) and the Dry Conversion Process (DCP) facility with its associated hydrofluoric acid recovery facility. Additional GNF-A activities 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 function. Machining of AE rotating parts takes place in the GE AE/SCO facility. **Figures 3.4-19 and 3.12-1** show locations and identifications of existing Site surface water features and wastewater treatment facilities. A more detailed description of the existing Wilmington Site facilities and operations can be found in the *Environmental Assessment for Renewal of Special Nuclear Material License No. SNM-1097* (NRC, 2007b) and the *Site Environmental Report Supplement for the Period 1995–2005* (GNF-A, 2007).

2.1.2.4.2 Proposed GLE Facility and Operations

During the operations phase of the Proposed Action, the Proposed GLE Facility would occupy 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** is an aerial photograph showing the location of the Proposed GLE Facility at the Wilmington Site at the same or similar scale as many of the figures presented in **Chapter 4** of this Report (*Environmental Impacts*). As discussed in **Section 2.1.2.4.1**, **Figures ES-1 and 1-1** show the location of the Site in relation to nearby cities, towns, landmarks, highways, and rivers and waterbodies.

Within the 100-acre (40-ha) Proposed GLE Facility would be an approximately 600,000 ft^2 (~56,000 m^2) operations building, which would include a cylinder dock for loading and unloading of cylinders, a vaporization room, a separator room, a laser room, a gas-handling area, an HVAC room, and a maintenance/repair area. Other facilities would include an office building, a warehouse/maintenance shop, storage warehouses, UF_6 cylinder storage pads, a security guardhouse, a vehicle maintenance and refueling building, a truck/trailer parking area, an administration building, and maintained landscaped areas.

To the east of the 100-acre (40-ha) Proposed GLE Facility and within the Main portion of the GLE Study Area (see **Figure 1-3**) would be several additional features that cumulatively would require approximately 13 additional acres (5 ha) to be cleared: access driveways connecting the Proposed GLE Facility to the North Road portion of the GLE Study Area; guard houses; a 300,000-gallon (1.1-million-liter) aboveground water-storage tank for fire protection; a sanitary wastewater lift station; a process wastewater lift station; an approximately 1-acre (0.4-ha) electric substation that would tie into existing high-voltage electrical power lines that already transect the Site through the transmission line corridor easement; and an 8-acre (3.2-ha) stormwater wet detention basin designed to capture and treat the runoff from the entire 100-acre (40-ha) Proposed GLE Facility and its supporting facilities for the purposes of removing water pollutants and attenuating peak runoff volumes. In addition to the electrical substation and wastewater lift stations listed above, utilities to the Proposed GLE Facility would include aboveground power lines; underground potable and process water lines; and underground lines for sanitary waste, process waste water, and treated liquid radiological waste. As further discussed in **Section 2.1.2.1.1**, underground lines would likely follow existing or proposed roadways in order to minimize environmental impacts. Waste treatment is described in **Section 2.1.2.4.2.2** and **Section 4.13.2.2.1** (*Wastewaters [Operation Impacts]*) of this Report.

2.1.2.4.2.1 Process Design for the Proposed GLE Facility

The Proposed GLE Facility would utilize industry-standard UF_6 containers and processes for material handling aspects of enrichment facility operations similar to those utilized at other uranium-enrichment facilities. These similar UF_6 handling processes include the movement of uranium feed stock from its solid UF_6 form in cylinders to gaseous form used in the enrichment cascade via vaporization techniques, the filling of UF_6 cylinders with UF_6 gas condensed into solid UF_6 form after the enrichment process, and the blending of UF_6 gas of different enrichments to create specific desired product enrichments.

The laser-based GLE enrichment process would utilize lasers tuned to specific frequencies to selectively excite UF_6 gas molecules to enable separation of the ^{235}U isotope in UF_6 feed stock. The result is a UF_6 product stream enriched in the ^{235}U isotope, and a UF_6 tails stream in which the fraction of ^{235}U isotope is reduced or depleted. The two resulting streams are separately collected in cylinders and temporarily stored on-site prior to final use.

2.1.2.4.2.2 Materials Use, Storage, and Disposal

The Proposed GLE Facility would use a variety of non-hazardous and hazardous chemicals and materials. **Table 2.1-2** lists chemicals and materials that would be used at the Proposed GLE Facility. UF_6 cylinder pads would be located near the main process building and would be segregated according to the type and size of cylinders that are stored. Many Facility-support functions, including utilities, materials, and services, would be typical of those required for any chemical processing plant. Waste streams are expected to be relatively small and typical of that from any UF_6-handling facility, and these wastes would be addressed by conventional means. Chemical process and decontamination equipment would be used, including decontamination spray booths, circulation pumps, uranium-recovery tanks and associated equipment, flocculent/filter systems to remove uranium from waste aqueous effluents, and associated piping and instrumentation. There would also be special facilities for maintenance and repair of the separator and laser systems. Additional details regarding specific buildings and areas that would be used for chemical use and storage and waste management are presented in Chapter 6 of the license application, *Chemical Process Safety*, and the Emergency Plan prepared for the Proposed Action.

Construction of the Proposed GLE Facility would generate solid waste materials that would need to be collected and transported off-site for recycling or disposal. No radioactive wastes would be generated as a result of construction. **Section 4.13** of this Report (*Waste Management Impacts*) provides details about waste management procedures as they would apply to operation of the Proposed GLE Facility, a summary of which is as follows:

- Operation of a treatment system at the Proposed GLE Facility for radioactive liquid wastewaters and pumping of the treatment effluent to the existing Wilmington Site final process lagoon facility for additional treatment
- Pumping of Proposed GLE Facility cooling tower blowdown to the existing Wilmington Site final process lagoon facility for treatment
- Pumping of Proposed GLE Facility sanitary wastewater to the existing Wilmington Site sanitary wastewater treatment facility for treatment
- Disposal of Proposed GLE Facility non-hazardous municipal solid waste at the New Hanover County municipal landfill (a Resource Conservation and Recovery Act [RCRA]–permitted Subtitle D landfill)
- Delivery of nonhazardous industrial waste to the Heritage Environmental Services' Indianapolis facility, either for treatment and burial or for routing to other GLE-approved facilities for reuse, reclamation, or treatment, depending on the waste composition
- Disposal of RCRA hazardous waste at the Heritage Environmental Services' RCRA-permitted Subtitle C treatment, storage, and disposal facility in Indianapolis, IN
- Temporary storage of UF_6 tails at the Proposed GLE Facility UF_6 storage area for ultimate acceptance by the DOE for disposal, in accordance with Section 3113 of the United States Enrichment Corporation, Inc. (USEC) Privatization Act (42 U.S.C. 2297h-11), or to a commercial depleted UF_6-conversion facility, should one become available
- Disposal of LLRW generated by Proposed GLE Facility operations at the Energy*Solutions* disposal facility in Clive, UT.

A stormwater wet detention basin would be constructed as a part of the Proposed Action to treat the runoff from the entire 100-acre (40-ha) Proposed GLE Facility, including the UF_6 storage pads.

Stormwater runoff from the UF_6 storage areas first would be routed to a holding pond for monitoring before the water is released to the stormwater wet detention basin. The stormwater wet detention basin would be located within the GLE Study Area to the east of the Proposed GLE Facility and would discharge through overland flow following existing topography toward the effluent channel and eventually to Unnamed Tributary #1 to Northeast Cape Fear River. **Section 4.4.2** of this Report (*Surface Water Impacts*) presents more details on how stormwater would be managed for the Proposed Action.

2.1.3 Reasonable Alternatives

As described in **Section 2.2**, evaluations have been performed for alternatives to the Proposed Action regarding technology, Facility design, site location, and Facility location, and the results of these evaluations have eliminated these alternatives. Other enrichment technologies have been examined, but have not been found to constitute reasonable alternatives (**Section 2.2.1**). Through a facility design optimization process, several design alternatives were eliminated through evaluation of potential environmental impacts, contamination of the Facility, ease of decommissioning, waste minimization, emergency response, and uranium-separation efficiency (**Section 2.2.2**). Alternatives to locating the Proposed GLE Facility at the Wilmington Site were considered, but were eliminated during a detailed multi-step site-selection process (**Section 2.2.3**). Alternative placements of the Proposed GLE Facility at the Wilmington Site were considered, but were dismissed due to the significant degree of additional mitigation necessary for implementation (**Section 2.2.4**).

2.2 Alternatives Considered but Eliminated

Evaluations have been performed for alternatives to the Proposed Action regarding technology, Facility design, site location, and Facility location. This section describes the evaluations and the resultant elimination of these alternatives from further consideration in this Report.

2.2.1 Elimination of Technology Alternatives

Section 1.2 of this Report (*Purpose and Need for the Proposed Action*) described the need for U.S. enrichment capacity; provided a basic overview of the history and status of current enrichment technologies; and included the following observations and conclusions:

- Worldwide and U.S. growth in demand for nuclear power is expanding significantly
- The United States is critically dependent on foreign sources for approximately 90% (on an SWU basis) of its enriched uranium requirements
- The United States has one major enrichment facility in cold shutdown (Portsmouth, OH) and another slated for closure by 2012 (Paducah, KY)
- Although other proposed enrichment facilities have been licensed (in New Mexico and Ohio) or are under consideration (in Idaho), none of those facilities has commenced operations or have completed construction. Regardless, as discussed in **Section 1.2.1.2.2** of this Report (*U.S. Enrichment Requirements*), there is a clear need for diverse domestic sources of enrichment services, including the Proposed GLE Facility, to narrow the widening gap between demand and supply and to reduce industry vulnerability to geopolitical disturbances and other potential sources of supply disruptions.

The following discussion provides additional comparisons of the key enrichment technologies. Due to the considerations presented below, the alternative enrichment technologies are eliminated from further evaluation in this Report as reasonable alternatives to the GLE laser-based technology.

The two commercial uranium-enrichment technologies currently in use are gaseous diffusion and gas centrifuge; the former dates from the 1940s, and the latter dates from the 1960s. Both technologies rely on the small difference in mass between ^{235}U and ^{238}U to separate the two isotopes. Both use mechanical methods to separate ^{235}U (the fissile isotope) from ^{238}U in the common feed material, UF_6, and produce a product stream (enriched in ^{235}U) and the waste, or "tails," stream (depleted in ^{235}U).

In the gaseous-diffusion technology, UF_6 is compressed to high pressure, after which it diffuses through porous barriers. Separation between the UF_6 molecules containing ^{235}U and those containing ^{238}U is based on the faster diffusion speed of the lighter isotope; however, because of the very small mass difference, the difference in diffusion speed is also very small. A large number of diffusion stages are required to achieve only small separation amounts, and the process requires many large compressor motors. As a result, the gaseous-diffusion process is highly energy intensive and has a very large physical footprint.

A gaseous-diffusion plant also requires a very large amount of cooling capability to remove the enormous amount of heat produced by the compressors. This removal is achieved by a large coolant system, which is itself very energy intensive. Furthermore, because of the vintage of the plants, the coolant fluid is limited to environmentally damaging chlorofluorocarbon (CFC). Gaseous-diffusion technology is now being phased out in the United States.

In the gas centrifuge technology, a second-generation technology, separation between the UF_6 molecules containing ^{235}U and those containing ^{238}U occurs as the heavier ^{238}U isotope achieves higher centrifugal force and tends to concentrate in the outer portion of the spinning centrifuge. Material in the inner portion is drawn off and passed to the next centrifuge to continue the enrichment process. A large number of centrifuges are required to achieve a given level of ^{235}U enrichment because of the small difference in mass between the two isotopes.

The gas centrifuge process is less expensive than the older gaseous-diffusion technology, both in terms of capital and operating costs. The following represent the principal "capital cost drivers:"

- The physical facility footprint is smaller
- The equipment requirements are less costly (primarily as a result of the number and cost of centrifuges vs. the number and cost of large compressor motors and diffusion barriers)
- The number of cascades required for any SWU capacity is smaller.

All of these capital cost drivers are interdependent to some degree. For example, the reduced number of cascades is a key reason why the facility footprint is smaller, as well as a key reason why the equipment requirements are less costly.

On the operating cost side, gas centrifuge technology is less energy intensive (i.e., more energy efficient) per SWU and has lower cooling requirements. It is currently the predominant uranium fuel enrichment technology worldwide.

The advent of third-generation laser-enrichment technologies from research initiated in the 1970s promises to further reduce these capital and operating costs. Because of their improved capability to isolate the ^{235}U isotope in an optical rather than a mechanical process, they are considerably more efficient than the older technologies (i.e., gaseous diffusion and gas centrifuge). Not only does this result in lower costs—reducing each of the capital and operating cost drivers mentioned above—but it also allows for more flexibility in product enrichment levels (the percentage of ^{235}U in the final product) at a given site. For example, enrichment levels can be more readily increased beyond the 3% to 5% required by current light water reactors in the United States (as compared to gaseous-diffusion and gas centrifuge technologies) in order to supply other commercial reactor fuel markets, including future advanced reactor designs. This can be accomplished relatively inexpensively compared to the older technologies. This flexibility is important in a dynamic marketplace.

Another anticipated benefit of laser-enrichment technology is that it can open up co-siting opportunities with other nuclear operations, primarily because of the smaller footprint of this technology on a site. When co-sited with a fuel-fabrication facility, for example, costs can be reduced and security maximized (in comparison with siting these operations at separate sites) as a result of the following:

- More unified and potentially higher levels of security training and operation
- Reduced transportation costs
- Economies of scale at a single site
- Lowered security risk when transporting nuclear material between co-sited facilities.

The three known laser technologies are the following:

- AVLIS (Atomic Vapor Laser Isotope Separation)
- MLIS (Molecular Laser Isotope Separation)
- SILEX.

The first two technologies are no longer being actively pursued in the United States, whereas the research and development supporting the SILEX technology have made it the most promising laser technology for fuel enrichment.

In AVLIS, metallic uranium is melted and vaporized to form an atomic vapor stream. This stream flows through a collector system, where it is illuminated by precisely tuned laser light from solid-state and dye lasers and the excited ^{235}U atoms are then collected. Principal advantages of the AVLIS process include a high separation factor between the ^{235}U and ^{238}U atoms (and thus, a relatively small number of stages to achieve a given enrichment target), low energy consumption (similar to the gas centrifuge), and a small volume of generated waste. Many countries, including the United States, conducted AVLIS research and development programs in the 1980s and 1990s, but most, if not all, of these programs have since been disbanded. The U.S. AVLIS program was discontinued by USEC in 1999, and AVLIS is not currently being deployed in commercial applications.

MLIS uses UF_6 as feed material and selectively excites ^{235}U with lasers. A second laser system then preferentially dissociates the pre-excited molecules to form UF_5 and free F atoms. The UF_5 (now enriched in the ^{235}U atom) then precipitates from the gas as a powder that is filtered from the gas stream. Each stage of the process requires conversion of the enriched ^{235}U back to enriched UF_6 for further enrichment. The principal advantages of MLIS are its low power consumption and its use of UF_6 as a process gas; however, it is less selective and more energy intensive (almost four times) than AVLIS and requires re-conversion steps for further enrichment. Most countries (including the United States) have abandoned their MLIS programs, although Japan continues to maintain a small research program.

The most recent laser-enrichment technology, SILEX, uses UF_6 as feed material. SILEX maintains the advantages of both MLIS and AVLIS over earlier-generation technologies in terms of high separation factors, lower energy consumption, lower cooling water requirements, and small footprint. In addition, a key advantage of SILEX over MLIS is that it avoids the need for re-conversion, and a key advantage of SILEX over AVLIS is the use of UF_6 as feed material. Recent success in SILEX implementation has led to the next step in the development process, a test-loop demonstration, with the ultimate objective of commercial deployment of the SILEX process, as modified by GEH (i.e., the GLE laser-based technology), in 2013. The test-loop demonstration is being performed at the Wilmington Site using a portion of the existing FMO facility. The test loop will be used as the first phase of commercial production facility design, testing, and qualification of manufacturing equipment and process. Data from the test loop will be used to verify GLE laser-based technology process economics.

The technical advantages of the GLE laser-based enrichment technology also result in reduced environmental impacts. For example, the smaller facility footprint for the same SWU capacity results in less disturbed land and a smaller impervious surface area. Additionally, the lack of CFC use and lower energy requirements result in additional environmental benefits. Overall, the GLE laser-based enrichment technology has a smaller environmental impact than alternative technologies. Due to the considerations presented above, the alternative enrichment technologies are eliminated from further evaluation in this Report as reasonable alternatives to the GLE laser-based technology.

2.2.2 Elimination of GLE Facility Design Alternatives

Through a Proposed GLE Facility design-optimization process, several design alternatives were eliminated from further evaluation based on consideration of the following factors:

- Environmental impacts
- Contamination of Facility structures (i.e., non-environmental)
- Ease of decommissioning
- Waste minimization
- Emergency response
- Uranium separation efficiency.

An example of the design and engineering review to reduce environmental impacts of the Proposed GLE Facility is the decision to limit the amount of UF_6 in the liquid phase. This design optimization reduces the likelihood of on-site and off-site consequences from a cylinder breach accident because liquid UF_6 is more likely to disperse than UF_6 in a solid form.

In accordance with 10 CFR 20.1406 (*Minimization of contamination*), the Facility was designed to minimize contamination of the Facility, minimize waste generation, and facilitate eventual decommissioning. The liquid radioactive waste treatment system was designed to minimize the amount of liquid and solid wastes and to utilize existing on-site process lagoons, rather than create a new effluent release pathway to the environment. Waste storage options such as in-ground tanks were avoided so as to minimize the difficulty of decontamination during the decommissioning phase.

2.2.3 Elimination of Site Alternatives

The objective of the Proposed GLE Facility site-selection process was to (1) evaluate and compare environmental impacts for alternative sites to evaluate whether any alternatives are "obviously superior" from an environmental perspective and (2) identify the preferred site for the construction and operation of the Facility. The site-selection process was conducted within the regulatory framework set by the National Environmental Policy Act (NEPA) of 1969, as amended, and the Atomic Energy Act of 1954, as amended.

Section 102(2)(c) of the NEPA requires that alternatives to a proposed site be evaluated. NEPA requires the NRC and other federal agencies to include an analysis of "alternatives to the proposed action" in Environmental Impact Statements on "major Federal actions significantly affecting the quality of the human environment…." The NRC implements Section 102(2) of NEPA in 10 CFR 51.

The proposed site location for the Proposed GLE Facility was identified as a section of land situated within the boundaries of the site of an operating nuclear fuel-fabrication facility in Wilmington, NC, licensed under an existing 10 CFR 70 license.

A generalized description of the approach used for the site-selection process is provided in **Section 2.2.3.1**. The results of this evaluation are described in **Sections 2.2.3.1**, **2.2.3.2, and 2.2.3.3** for each step in the process, including the results of a qualitative cost-benefit analysis (CBA).

2.2.3.1 Methodology and Approach

This section provides the rationale for identifying candidate sites in the region under consideration for the GLE project and describes the multi-step process that was used to systematically review and screen sites.

2.2.3.1.1 Introduction

The objective of the site-selection process was to evaluate the 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:

- Identification of candidate sites
- Initial screening
- Coarse screening
- Site-reconnaissance visits
- Fine screening
- Qualitative CBA.

The process began with identifying candidate sites to be considered for the GLE project. These candidate sites were then subjected to an initial screening step that eliminated those sites located in areas of significant seismic, tectonic, and flood hazards. Sites that passed the initial screening step then entered the coarse-screening step, which considered criteria related to property size requirements or potential impediments to the transfer of property ownership. Sites that failed one or more of these criteria were eliminated from further consideration. At this point, reconnaissance visits to the remaining sites were conducted to identify potential issues beyond the initial and coarse screening. Sites that passed this reconnaissance step entered a fine-screening step, which considered detailed criteria that addressed public health and safety; community and environmental impacts; and engineering, stakeholder, cost, and schedule considerations. Criteria were considered for each lifecycle phase of the project (i.e., pre-construction, construction, operation-production, and decommissioning), as applicable.

To process the large amount of decision criteria and to handle the complexity of the decision-making process, a Multi-Criteria Decision Analysis (MCDA) technique was chosen to perform the fine screening. The process initially consisted of a weighting step in which criteria were weighted against each other in a pairwise comparison that determined their relative importance to the operation, processes, and each of the lifecycle phases of the Proposed GLE Facility. In a second pairwise comparison step, the sites were ranked for each of the criteria based on qualitative or quantitative data for each site location. A site score, or ranking, was generated for each site based on an aggregation of scores for each criterion and hierarchy level.

Once the fine-screening step generated the numerical ranking of the sites, a qualitative CBA was performed. The qualitative CBA results were then used to compare the alternative sites to the proposed site for the purpose of determining if an alternative site was "obviously superior" to the proposed site. The proposed site was selected as the preferred site based upon the determination that there is no obviously superior alternative site to the proposed site.

The entire site-selection process is summarized in **Figure 2.2-1**.

2.2.3.1.2 Process Used for Selecting Candidate Sites

Operations at the Proposed GLE Facility would require shipping uranium feed materials primarily from the Honeywell facility in Metropolis, IL, and the Cameco facility in Port Hope, Ontario, Canada. Additionally, some uranium feed materials will be supplied from overseas sources and arrive at ports in Baltimore, MD, and Portsmouth, VA. Products from the Proposed GLE Facility would be delivered to fuel manufacturing facilities in Wilmington, NC, Columbia, SC, and Richland, WA. The transportation mode that would be predominately used to ship these materials is truck transport; therefore, locating the Proposed GLE Facility within reasonable driving distances from operating fuel-cycle facilities offers the benefits of facilitating material transport to comply with safety and security requirements and optimizing material transportation costs.

To identify locations conducive to the realization of these benefits, a 600-mile (966-km) radius was drawn around the centroid formed by the locations of the operating fuel-cycle facilities (NRC, 2006b) in the eastern United States (**Figure 2.2-2**). The Richland, WA, facility was excluded from calculating the centroid due to its distant location in the northwestern part of the country. The entire region within this circle was examined to identify specific sites that could be included as candidate sites for the site-selection process. Identification of the candidate sites for the site-selection process began with considering realistic approaches to locating the Proposed GLE Facility within the designated region. One potential approach would be to purchase and build the Facility on an undeveloped tract of land. A second approach would be to co-locate the Proposed GLE Facility at a nuclear facility site or to build the Facility at a site previously considered for a nuclear facility. It was decided to focus the examination of the candidate sites on those sites that are currently dedicated to fuel-cycle facilities, or have previously been considered for siting a nuclear facility (where the project was either stopped or has been recently re-proposed), as described below.

From a site-selection standpoint, these types of sites offer distinct advantages over undeveloped land tracts given the specific commercial objectives, including scheduling considerations, associated with the GLE project. The nuclear facility-related sites have been vetted as reasonable candidate sites from other locations within the designated region for building a new nuclear facility by previous siting studies and regulatory licensing proceedings. Site characterization information and data required for the GLE project site-selection process often are available from the licensing documents and other studies prepared for these sites. Many of the sites have local or community support for a nuclear facility. Sites with nuclear facilities may have the existing nuclear operations infrastructure components already in place that would be needed and can be shared by the Proposed GLE Facility.

2.2.3.1.3 Initial Screening

The initial screening step identifies hazard zones created by seismicity, recent faulting, or flooding that could potentially jeopardize operational safety at any of the 22 candidate sites. The specific sites are listed and discussed further in **Section 2.2.3.2.1**.

2.2.3.1.3.1 Methodology and Approach

NRC Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Stations*, suggests that this step use any methodology that surveys the entire region without extensive analysis (NRC, 1998). Specifically, the information needed to evaluate potential sites at this initial stage of site selection is assumed by NRC Regulatory Guide 4.7 to be limited to information that is obtainable from published reports, public records, public and private agencies, and individuals knowledgeable about the locality of a potential site. NRC Regulatory Guide 4.9, *Preparation of Environmental Reports for Commercial Uranium Enrichment Facilities*, and NRC Regulation 10 CFR 100.23 (*Geologic and seismic siting criteria*) indicate that seismic and geologic site characteristics, among others, should be evaluated relative to the safe operation of a nuclear facility (NRC, 1975). Because national-scale data have been developed that illustrate the relative level of risk associated with seismic-related features in the United States, it is straightforward to apply these data to the initial screening process using geographic information systems (GIS) mapping techniques (**Figure 2.2-3**).

2.2.3.1.3.2 Decision Criteria and General Procedures for Initial Screening

The following three screening criteria were considered during the initial screening step in evaluating the potential hazards at each of the candidate sites:

- Impact of seismic hazard zones
- Proximity of quaternary fault zones
- Flood potential.

These criteria are considered Go/No Go criteria, and failure of one or more of these criteria results in a site not passing the initial screen. The following paragraphs outline these three initial screening criteria in more detail.

Seismic Hazard Zone. The U.S. Geological Survey (USGS) Earthquake Hazards Program publishes seismic hazard map data layers that display Peak Ground Acceleration (percent g) with 10% and 2% probability of exceedance (PE) in 50 years (i.e., approximately a 1- in 500-year event and 1- in 2500-year event, respectively) (USGS, 2005a). The percent g (i.e., Peak Ground Acceleration) is the maximum acceleration experienced by a building or object at the ground level during the course of an earthquake motion on uniform firm-rock site conditions. The Federal Emergency Management Agency (FEMA) states that the USGS Seismic Hazard maps with a 2% PE in about 2,500 years provide a general assessment of relative ground motions, but are at a scale that does not help in a site-selection process (FEMA, 2006). In addition, NUREG 1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility— Final Report,* requires applicants to provide earthquake accelerations associated with a 500-year earthquake for the Integrated Safety Analysis Summary (NRC, 2002). Therefore, the 10% PE in 50 years hazard map was chosen for use in evaluating the candidate sites. Sites in regions with higher risk areas (i.e., where there is a 10% chance of an earthquake generating a percent g equal to or greater than 10 percent g within any 50-year period) were excluded from further consideration (**Figure 2.2-3**). A safe range of 10 percent g or less is consistent with safe-shutdown (for nuclear power plants) earthquake ground motion, as outlined in 10 CFR 100 (*Reactor Site Criteria*) and 10 CFR 50 (*Domestic Licensing of Production and Utilization Facilities*), and is therefore considered conservative for the Proposed GLE Facility.

Quaternary Fault Zone. The USGS Earthquake Hazards Program publishes the Quaternary Faults and Folds Database (USGS, 2005b), which describes faults in the United States that are believed to be sources of earthquakes greater than magnitude 6 that have occurred over the past 1.6 million years. It is intended to serve as an archive of historical (i.e., occurring less than 150 years ago) and ancient earthquake sources, which can be used in seismic-hazard analyses, such as those conducted when siting nuclear reactors; developing seismic design provisions for buildings, bridges, and utilities; and providing earthquake-preparedness education. The national map of quaternary faults, compiled by the USGS, is provided in **Figure 2.2-4**.

Flood Zone. Flood potential is based on a 500-year flood plain (i.e., 0.2% chance of a catastrophic flood occurring at the level of the 500-year flood plain during any year). This information is available from published flood maps issued by FEMA. These maps can be viewed online at state Internet sites or purchased from FEMA for the areas of interest. A determination of flooding potential was made based on the results of other publicly available nuclear site-selection studies and Web-based flood-mapping applications.

2.2.3.1.4 Coarse Screening

Sites that pass the initial screening are then evaluated using coarse-screening criteria that address non-safety related Go/No Go criteria.

2.2.3.1.4.1 Methodology and Approach

The coarse-screening criteria are straightforward exclusions based on business factors. The coarse-screening criteria relate to the requirements of the property size or potential impediments to the transfer of property ownership to GLE for operation of the Proposed GLE Facility. A given site may be eliminated on the basis of failing to meet a single criterion or any combination of multiple criteria.

2.2.3.1.4.2 Decision Criteria and General Procedures for Coarse Screening

Four screening criteria were considered during the coarse-screening process:

- Property size of a site
- Government ownership of a site
- Ongoing, past, or anticipated litigation or high potential for local or regional political opposition
- Whether a site was subject to regulatory actions or activities under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Superfund or RCRA Corrective Action programs.

These criteria are Go/No Go criteria, and failure of one or more of these criteria results in a site not passing the coarse screening. The following paragraphs outline the four coarse-screening criteria in more detail.

Property Size. The Proposed GLE Facility footprint requires a contiguous area of approximately 100 acres (40 ha). Those sites that did not meet the minimum 100 acres (40 ha) were eliminated.

State-, County-, or Federally Owned Sites. These sites were eliminated from consideration because of anticipated delays associated with the potential acquisition of real property at those locations for the GLE project (i.e., the transfer of public property to a private owner is typically a lengthy process that could introduce considerable and commercially unacceptable delay into the planned schedule for construction and operation of the Proposed GLE Facility).

Litigated Sites/High Potential for Local or Regional Political Opposition. Sites under past, current, or anticipated litigation were eliminated because of the potential difficulties associated with purchasing those sites and transferring ownership to GLE. Also, litigation and political opposition could hinder or delay the state or local permitting processes (e.g., water quality), as well as the NRC licensing process.

CERCLA Superfund Sites and RCRA Corrective Action Facilities. Sites on either the U.S. Environmental Protection Agency (EPA) CERCLA Superfund National Priority List (NPL) or the RCRA Corrective Action Facility list (U.S. EPA, 2007a, 2007b) were eliminated because of the anticipated difficulties associated with the potential purchase of those sites and the transfer of ownership to GLE.

2.2.3.1.5 Site Reconnaissance

After the coarse-screening step, a site-reconnaissance step was conducted to determine any Go/No Go criteria that could only be identified by an on-site visit and discussions with site employees and management. This step consisted of GLE site-selection team members evaluating each site during on-site visits and meetings with site management and/or property owners. Only sites that passed this reconnaissance step entered the fine-screening phase.

2.2.3.1.6 Fine Screening

The fine screening was the last screening phase in the site-selection process and consisted of a detailed site-level evaluation. This screening was based on public health and safety factors, as well as potential environmental and socioeconomic impacts, for each of the sites remaining after the previous screening steps. The evaluation also compared potential risks (e.g., geological, meteorological) for the remaining sites in regards to safe operation within the associated environmental setting.

To perform this evaluation, an MCDA technique was applied by performing multiple rankings for the same set of criteria, which included both qualitative and quantitative information for the factors, impacts, and risks described in the paragraph above, along with the opinions and preferences of various stakeholders. The individual fine-screening steps are described in more detail in the following paragraphs.

2.2.3.1.6.1 Criteria Identification

Examples of similar siting studies and related documents (**Table 2.2-1**) were used as an initial guide to identify a relevant list of criteria. This preliminary list of site-selection criteria was then compared against appropriate federal regulations and regulatory guidance (**Table 2.2-2**) to ensure that a thorough site-selection process had been established. In addition, state and local regulations, engineering requirements, cost considerations for construction and operation, and general safety protocols were addressed. The compiled criteria were defined as to their application to the proposed technology, and the specific acceptance criteria (e.g., goals and specific action thresholds) were identified as endpoints for the evaluation.

Endpoints are either qualitative or quantitative measures by which a site can be distinguished from another site (i.e., quantitative [distance in miles to nearest highway] or qualitative [degree of a certain condition]). In addition, references for regulations or regulatory guides were documented for each criterion. The fine-screening criteria are not designed to cause a site to fail the screen; rather, they are criteria that—once integrated into the MCDA process—are weighted according to their importance. However, criteria that were not definitive for the alternatives evaluated in allowing a measure of variation or differences between sites were excluded. Criteria were identified according to their relevance to the Facility’s lifecycle phases, which include pre-construction, construction, operation, and decommissioning. The pre-construction phase addresses criteria specific to planning, licensing, and site preparation. Some criteria address more than one lifecycle phase.

2.2.3.1.6.2 Application of the Multi-Criteria Decision Analysis

Once the site-selection criteria were identified, the next step consisted of determining the use of a decision methodology. An MCDA technique was chosen because it is suitable for a complex decision-making process incorporating numerous criteria as required by the site-selection task. In addition, the technique is flexible, easily implemented with commercially available software, and allows for data variability, which is a factor for the sites remaining in the fine-screening process. The technique’s steps are summarized below:

- **Building the criteria hierarchy.** Once all of the necessary criteria were identified, the criteria were grouped with respect to public health and safety, potential environmental and socioeconomic impacts, potential risks to the Facility within the environmental setting, and potential impacts to overall costs and schedule.

- **Criteria weighting.** The selected MCDA method provided a straightforward and systematic process to understand, implement, and be conducive to consensus building within a group setting. The weighting step involves multiple parts:
  - Formation of a decision panel for MCDA process
  - Organization of criteria into scoring instruments
  - Independent evaluation and pairwise comparisons by panelists
  - Working meetings with panelists for consensus building and calculation of weights
  - Review and discussion of individual scores by panelists and development of final scores through group consensus. Development of a rationale statement by panelists to support their judgment and pairwise comparison values.
- **Site ranking.** Subsequently, the sites were compared and ranked for each criterion. In the case where there are criteria with quantitative data, the MCDA calculated the site rank using the actual values for the parameters associated with the criterion; in the case of qualitative data or the combination of qualitative and quantitative data, comparisons and rankings were assigned by technical staff with expertise in the type of criterion being evaluated.

A more detailed overview of these steps is provided in the following paragraphs.

Building the Criteria Hierarchy. In this step, each criterion was repeatedly scrutinized based on its importance and applicability to the proposed technology by technical and business experts. After careful consideration, criteria that evolved as not applicable were removed from the criteria universe. Criteria that were of low importance, but were nevertheless applicable to the decision process, remained in the criteria universe and were subjected to the subsequent fine-screening criteria weighting step. Importance statements were developed for each criterion to help facilitate the subsequent criteria-weighting process. Once the criteria list was considered applicable, appropriate, and relevant to the proposed technology, the criteria were organized into criteria trees under appropriate clusters and then grouped into levels of detail, such as subgroups of subject matters (e.g., infrastructure, site development) with supporting criteria for the respective cluster. Criteria details include definitions, qualitative or quantitative endpoints, criteria and endpoint sources (e.g., previous siting study), a crosswalk to pertinent regulations and regulatory guides, and the data sources for each of the criteria endpoints. There are instances where a subgroup is not further supported by individual criteria; in those cases, the subgroup itself becomes a criterion. It is important to note that the numeric characterization of the criteria clusters does not imply a sequence of importance, but was merely a way to organize the hierarchy.

Cluster I – Minimizing Impacts to Time and Cost. Cluster I contains criteria that affect the cost and schedule for the Facility. These criteria are largely driven by business considerations and can be mitigated by either higher start-up and/or operational expenditures or by schedule adjustments. The applicable criteria groups under this cluster are Site Physical Characteristics, Infrastructure, Contamination, Site Development, and Co-Location. Except for Site Development, all subgroups have supporting criteria.

Site Physical Characteristics. The Site Physical Characteristics group describes basic site conditions. These conditions can interfere with the construction phase, and, if unfavorable, might require modifying the Facility design. This group considers impediments to construction, such as easements, shallow or exposed bedrock, availability of on-site or nearby borrow fill materials, and conformance of the site to the most efficient layout of Facility footprint and height requirements. The data to support these criteria were obtained from existing documentation and site reconnaissance. The Site Physical Characteristics group consists of three subgroups:

- Expansion capability
- Facility layout
- Physical characteristics affecting construction.

Existing Infrastructure. The Existing Infrastructure group describes available resources for hazardous waste handling, security/emergency response, transportation, water systems, and power sources. The availability and quality of existing infrastructure can significantly impact cost and schedule by potentially eliminating the need to obtain permits, interact with local regulatory agencies, or hire additional contractors. The data for these criteria were largely provided by spatial data layers (i.e., GIS files). The Existing Infrastructure group consists of five subgroups:

- Hazardous and radioactive materials and waste-handling facilities
- Security and emergency response systems
- Transportation access and routes
- Water systems
- Power sources and transmission lines.

Contamination. The Contamination group describes existing contamination of environmental media (e.g., air, groundwater, surface water, soil, vapor intrusion). Existing on-site or adjacent contamination may result in costly and lengthy remediation and monitoring activities, potentially impacting all lifecycle phases. The data for these criteria were either provided by GEH, existing site assessments, or other site-specific documentation. The Contamination group consists of two subgroups:

- On-site contamination
- Adjacent contamination.

Site Development. Site development describes physical preparation (e.g., grading, road access, physical security), potential for construction delays due to weather extremes, and operation and construction permitting. Site development issues can drive cost and schedule during the pre-construction and construction phases. There are no other supporting subgroups. Data were provided by qualified technical staff.

Co-Location. Co-location of an existing nuclear facility on-site or nearby may have positive and negative effects on emergency planning, construction, and licensing. Positive impacts may include infrastructure sharing and more efficient licensing, whereas existing emergency planning and parallel ongoing construction can interfere with schedule. The Co-Location group consists of the following three subgroups (data for the Co-Location subgroups were provided by site reconnaissance and existing site-specific documentation):

- Emergency planning
- Efficiency of construction
- Site licensing.

<u>Cluster II – Impacts to the Facility</u>. The Impacts to the Facility group describes natural and man-made conditions that could impact the Facility during all of its lifecycle phases. This group consists of the following: Meteorology and Climatology with supporting criteria, Co-Located or Nearby Hazardous Land Uses, Geologic Hazards with supporting criteria, and Wildfires.

Meteorology and Climatology. The Meteorology and Climatology group describes weather events that can potentially damage the Facility, compromise safety and security, create related hazards (e.g., flood, fire, debris flows, missiles), and interrupt operations for extended periods of time. In addition, impacts on the workforce and community infrastructure are possible. The supporting four subgroups describe the potential effects of severe weather events, including the following:

- Hurricanes
- Tornadoes
- Severe storms
- Lightning.

Co-Located or Nearby Hazardous Land Uses. Co-location or proximity to hazardous land uses, such as tank farms, fueling terminals, chemical plants, pipelines, airports, military installations, nuclear facilities, and transportation routes, increase the potential for accidents that may compromise the safety and operation of the Facility. Data are generated from spatial data layers and from Environmental Data Resources reports (i.e., EDR, 2007), which list industrial facilities within a given radius.

Geologic Hazards. The Geologic Hazards group describes settlement and seismic events that can compromise the structural integrity of the Facility, along with safe operation and site security. The two supporting subgroups describe the effects to design and engineering complexities associated with mitigating risks from geologic hazards, including tectonic and seismic conditions (e.g., earthquakes), as well as ground conditions of soils and unconsolidated sediments at each site. Data were primarily obtained from the USGS, as well as existing site-specific documentation. The Geologic Hazards group consists of two subgroups:

- Ground instability
- Capable faults and seismic hazards.

Wildfires. Wildfires could pose a danger to the Facility and the surrounding infrastructure, even though to some degree, direct impacts to the Facility from wildfires can be mitigated by design (e.g., firebreaks).

Cluster III – Impacts to the Environment. The Impacts to the Environment group describes impacts that the Facility could have on the environment during all of its lifecycle phases. This group consists of Water Resources with supporting criteria; Air Quality; Public Health and Safety with supporting criteria; Ecology with supporting criteria; Socioeconomic Impacts with supporting criteria; Historic and Archeological Sites; Noise with supporting criteria; and Visual and Scenic Resources.

Water Resources. The Water Resources group describes Facility characteristics and activities that can affect the quality and quantity of surface waters and groundwater used locally and downstream/downgradient. This group is supported by three subgroups that evaluate how the Facility's use of groundwater and/or surface water could add additional stress to hydrologic systems and potentially diminish supply for local users and water needed to sustain ecological habitat. Lowering of the water table could also impact groundwater-supplied wetland areas. Paved surfaces can impact infiltration to shallow aquifers and affect recharge to deeper aquifers. Construction activities can channel runoff and add sediment to surface waterbodies, altering flow patterns and destroying habitat while causing some aquatic species to relocate into other areas. Data are primarily obtained from existing site-specific documentation. The Water Resources group consists of three subgroups:

- Physical surface water impacts
- Water quality impacts

- Water quantity impacts.

The water quality and quantity impacts address groundwater and surface water impacts.

Air Dispersion Characteristics. The Air Dispersion Characteristics group describes the principal factors that affect dispersion of air pollutants emitted from the Facility to ambient air. Wind speed, stability of the atmosphere, and terrain determine the degree to which pollutants can be dispersed in the downwind direction.

Public Health and Safety. The Public Health and Safety group evaluates human exposure risk to population centers and public facilities (i.e., direct pathways, such as schools, hospitals, and parks; and indirect pathways, such as agricultural uses and drinking water). During Facility operation, there may be chemicals, radioactive materials, and air pollutants that are routinely or accidentally released to the environment. The various possible pathways for human exposure include direct radiation, immersion in airborne effluents, internal exposure from inhalation of airborne effluents, and ingestion pathways through release of materials deposited on the ground surface, agricultural products, vegetation, and potable water sources. Based on NRC Regulatory Guide 4.9, a 5-mile (8-km) area of review is used. The direct and indirect impacts were mapped from spatial data layers. The Public Health and Safety group consists of two subgroups:

- Direct pathways
- Indirect pathways.

Ecology. The Ecology group evaluates effects to species and habitat present at or near the Facility site. Protection of endangered species habitat is required by federal law (Compliance with U.S. Fish and Wildlife Service [FWS], Endangered Species Act [ESA] Section 7 and State ESA [General Statutes 113–331, 202.12-202.22]). In some cases, impacts can be avoided or mitigated. The Ecology group consists of two subgroups:

- Endangered/threatened/rare or regionally important plant and animal species
- Habitat.

Socioeconomics. The Socioeconomics group is supported by five impact-area-specific subgroups, which are used to evaluate impacts to socioeconomics of surrounding communities from capacity addition. Positive impacts can include employment, increased tax revenue, improved community facilities, and support to local emergency planning efforts. Negative economic impacts can be present if the land could be used for other purposes, such as agriculture, and include a loss of income and jobs and increased traffic congestion. Socioeconomic impacts, including potential impacts on low-income and minority populations, are important regulatory and community concerns. Estimated economic impact is important in generating local support. The Socioeconomic Impacts group consists of five subgroups:

- Population and demographic impacts
- Social impacts
- Economic impacts
- Environmental justice
- Traffic impacts.

Historic and Archaeological Sites. The Historic and Archaeological Sites group describes the presence of on-site or nearby historic or archaeological sites. Archaeological sites can include prehistoric and historic occupations, roads, landscapes (e.g., bodies of water, open space, rock outcroppings, trails), and other landmarks (e.g., U.S. National Park Service landmarks). Historic sites can include standing architecture, all or parts of buildings, and cemeteries, among others. Construction, operation, or eventual decommissioning of the Facility may affect historic properties, which are historic or archaeological sites listed in or eligible for listing in the National Register of Historic Places. Transmission lines and corridor rights-of-way should also be identified to determine their potential impacts to any such historic properties. Section 106 of the National Historic Preservation Act (NHPA) of 1969 requires that the effect on historic properties be taken into account for any project involving federal agencies, permitting, and/or monies. All cultural resource consultations and investigations for the Proposed GLE Facility are in compliance with the NHPA. Paleontological resources must be given consideration under the NEPA, the Federal Land Policy and Management Act, and some state culture resources regulations. Sites that are developed for public access may experience decreases in visitor numbers, and mitigation may be required. There are several recognized benefits associated with historic and archaeological sites, including the development of economic benefits to the community in the form of tourism and museums, development of educational resources for the refinement or development of historical perspective, determination of the ecological relationship between ecological and cultural worlds that can provide guidance with modern decision making, development of forensic methods and a training site for students in basic scientific skills, and development of community identity and interaction.

Noise. The Noise group describes impacts from the Facility, including Facility operations and related traffic, to ambient noise levels. Beyond the aesthetic impact of noise, there are potential health impacts, but these can be addressed with engineering controls.

Visual Impacts. The Visual Impacts group evaluates the aesthetic effect of changes to the natural landscape (e.g., vegetation, topography, views, surroundings) by the Facility (e.g., Facility location on the site, layout, design, changes to the natural terrain). These changes have the potential to alter the visual vantages and perspective of existing and future neighbors and nearby residents and can result in a potential health impact. Neighboring land uses may also be affected, and the compatibility with existing, planned, and potential uses should be considered. The visual impacts of building a facility on a site with unique natural aesthetic features (e.g., hydrology, topography, plant/animal species) are likely to be greater than those of building a facility on a site with few natural aesthetic features.

Cluster IV – Employment and Stakeholders. The Employment and Stakeholders group describes effects concerning employment and potential stakeholder issues during the various lifecycle phases. This group consists of Labor Force and Stakeholder Support, both with supporting criteria.

Labor Force. The Labor Force group examines the availability and quality of skilled construction and operation labor force necessary to meet construction schedules needed for Facility operation. Lack of a locally available labor force can affect costs. The Labor Force group consists of two subgroups:

- Construction labor force
- Operation labor force.

Stakeholder Support. This Stakeholder Support group evaluates the support for the Facility from local and state governments and the general public. Lack of stakeholder support can result in schedule delays. The Stakeholder Support group consists of two subgroups:

- Community
- Government.

Criteria Weighting. After building the hierarchy of decision criteria, the next step was to establish priorities among the elements of the hierarchy. A series of pairwise comparisons between elements of the hierarchy was used to determine the priorities among the elements. The results of these comparisons were used to calculate weights for each criterion. The following is the importance scale for the pairwise comparison:

- **1 – Equal importance.** Two activities contribute equally to the objective.
- **3 – Moderate importance.** Experience and judgment slightly favor one activity over another.
- **5 – Strong importance.** Experience and judgment strongly favor one activity over another.
- **7 – Very strong or demonstrated importance.** An activity is favored very strongly over another or its dominance is demonstrated in practice.
- **9 – Extreme importance.** The evidence favoring one activity over another is of the highest possible order of affirmation.
- **2, 4, 6, and 8.** For compromise between the above values; was used by each panelist during their independent study to interpolate judgments numerically.

Relative weighting represents a suggested indication of the overall importance for a specific criterion. Some criteria may have significance to more than one criteria group and relate to technical and business details in the decision process. Multiple reviews were performed of criteria used in the hierarchy and during each phase of the decision process to safeguard against repetition in how attributes were defined and associated with the objectives by the panel. Although criteria were eliminated if more than one criterion expressed essentially the same aspect (so not to give additional weight to any one attribute), the criteria set was kept as complete as possible.

A small panel of decision makers uniquely qualified to provide expert judgment was established. Panelists' biographical summaries are documented in **Appendix C** of this Report (*Background Summaries of Panelists*). One member of the panel acted as facilitator for the process and elicitor in assisting the panel to express judgments and rationale. In addition, other subject-matter professionals who were familiar with the substance of the decision being made and the techniques used for the decision analysis were drawn upon during the process. Technical staff served as recorders and captured responses from panel members and consensus statements. Panel discussions and processes were also observed by a project quality assurance team member. Through group discussion, team members were encouraged to reach a consensus during weighting and ranking. If a consensus could not be reached, the geometric mean was applied. Consistency checks were performed at points in the weighting process to evaluate the results of panel decisions and assure accuracy in the process.

Site Ranking. The rank assigned to the site for a specific criterion was based on site-specific data collected for each site. Relative ranking was only applied to criteria that did not have a specific value associated with the endpoint (i.e., qualitative data). Criteria with specific endpoint values were simply normalized and included as weights (i.e., quantitative data). Rankings for more qualitative criteria were assigned by individuals who were either technically knowledgeable or familiar with the type of engineering and operations criteria being evaluated for the proposed technology.

Because the level of data available for each of the sites selected for the fine-screening step was different, a set of guidelines was developed and documented to maintain a level of consistency in the evaluation. The following are examples of data characteristics that could lead to bias in evaluation and subsequent ranking:

- Criterion type (i.e., qualitative or quantitative)
- The level of detail available relative to each criterion

- The scale of the data (i.e., the reported information was based on site-specific and measured data, or it was estimated from regional or local characteristics)
- General data quality (e.g., the reference sources used, numbers of sources used)
- Unavailable data (e.g., a procedure was developed to apply an appropriate score).

The criteria weights were determined through a series of linear equations, based on the inputs provided in the matrices by the participants. For the same criterion, the mathematical product of the following yields a score for a given site under consideration:

Criteria Weighting x Site Ranking

This calculation was performed for each criterion. The process rolled up through all higher levels of hierarchical groupings (i.e., subgroups, groups, and clusters).

The site scores for each criterion were combined to obtain the overall score for each site. Based on the site score, the sites could then be ordered according to the high-low rules previously established for numerical ranking.

2.2.3.1.7 Qualitative Cost-Benefit Analysis (CBA)

2.2.3.1.7.1 Methodology

After the fine-screening step, a qualitative CBA was conducted to assess if an alternative site was "obviously superior" to the proposed site. The proposed site was selected as the preferred site if the qualitative CBA indicated that there was no obviously superior alternative site to the proposed site. The qualitative CBA compared the sites under consideration for the construction and operation of the Proposed GLE Facility. The CBA compared the sites across various criteria identified as a basis for site selection. Costs and benefits to be examined included private costs and benefits accruing to GLE and public benefits and costs accruing to society. Finally, an overall assessment of the relative costs and benefits of the sites identified either the proposed site or an alternative, obviously superior site as the preferred site.

2.2.3.2 Site-Selection Screening Results

The site-selection process initially considered 22 sites that were located within a 600-mile (966-km) radius around the centroid formed by the locations of the operating fuel-cycle facilities in the eastern United States (**Figure 2.2-2**). The 600-mile (966-km) radius was selected to facilitate operations at the Proposed GLE Facility, which requires shipping uranium feed materials by truck transport primarily from uranium-conversion facilities in Metropolis, IL, and Port Hope, Ontario, Canada; transporting uranium feed materials from overseas sources to ports in Baltimore, MD, and Portsmouth, VA; and delivering the products from the Proposed GLE Facility to fuel manufacturing facilities in Wilmington, NC, and Columbia, SC. Even though products would also be delivered to Richland, WA, this facility was excluded in generating the centroid due to its remote location in the northwestern part of the country. See **Table 2.2-3** for more detailed information about the 22 candidate sites and their history and status as of 2007.

These 22 candidate sites were then subjected to an initial screening step that eliminated three sites (Columbia, SC; Metropolis, IL; and Paducah, KY) located in areas of significant seismic hazards (**Table 2.2-4**).

Sites that passed the initial screening step then entered the coarse-screening step, which considered criteria related to property size requirements or potential difficulties that could be associated with the transfer of property ownership. Sixteen sites failed one or more of these criteria and were eliminated (Bailly, IN; Barnwell, SC; Bellefonte, AL; Clinch River, TN; Erwin, TN; Forked River, NJ; Hartsville, TN; Lynchburg, VA; Marble Hill, IN; Midland, MI; Oak Ridge, TN; Phipps Bend, TN; Portsmouth/Piketon, OH; Savannah River, SC; Sterling, NY; and Yellow Creek, MS) (**Table 2.2-5**).

The three remaining sites (Cherokee, SC; Morris, IL; and Wilmington, NC) entered the reconnaissance step. Visits to the three sites were conducted to identify potential issues beyond the initial and coarse screening. Cherokee, SC, was eliminated by the reconnaissance-step results.

Two sites, Morris, IL, and Wilmington, NC, passed this reconnaissance step and entered the fine-screening step, which contained detailed criteria that addressed public health and safety, environmental, engineering, stakeholder, and cost and schedule considerations. The fine-screening step revealed a slightly higher ranking score (9.5%) for the Wilmington, NC, site compared to the Morris, IL, site.

Both sites were then subjected to a qualitative CBA that compared the sites across various criteria and determined private costs and benefits accruing to GLE, as well as public benefits and costs accruing to society. The net benefits of locating the Facility in Wilmington were found to be slightly higher than those associated with locating it in Morris.

The results for each of the site-selection steps are discussed in the following paragraphs.

2.2.3.2.1 Selection of Candidate Sites

Based on the approach described in **Section 2.2.3.1.2**, a search was conducted to identify sites of existing nuclear fuel-cycle-related facilities and proposed new nuclear facilities, as well as sites that were previously considered for building a nuclear facility that are located within the 600-mile (966-km) radius circle. Based on the results of this search, 22 sites were chosen as candidate sites for the GLE project site-selection process. The selected sites and the owners of the sites are listed below.

Existing fuel cycle and other nuclear facilities:

- Barnwell, SC – State of South Carolina/Energy*Solutions*
- Columbia, SC – Westinghouse Electric Company, LLC
- Erwin, TN – Nuclear Fuel Services, Inc.
- Lynchburg, VA – AREVA NP, Inc. and BWX Technologies, Inc.
- Metropolis, IL – Honeywell International, Inc.
- Morris, IL – GE
- Oak Ridge, TN – DOE
- Paducah, KY – USEC
- Portsmouth/Piketon, OH – USEC
- Savannah River, SC – DOE
- Wilmington, NC – GE.

Sites previously or currently considered for nuclear facility siting:

- Bailly, IN – Northern Indiana Public Service Company
- Bellefonte, AL – Tennessee Valley Authority

- Cherokee, SC – Duke Energy Corporation (Duke Energy)
- Clinch River, TN – Tennessee Valley Authority
- Forked River, NJ – AmerGen Energy Company, LLC
- Hartsville, TN – Tennessee Valley Authority
- Marble Hill, IN – Debbie and Dean Ford
- Midland, MI – MCV Power Partners, Inc.
- Phipps Bend, TN – Tennessee Valley Authority
- Sterling, NY – Cayuga County
- Yellow Creek, MS – Tennessee Valley Authority.

More detailed information about the candidate sites and their history and current status is presented in **Table 2.2-3.**

2.2.3.2.2 Initial Screening

2.2.3.2.2.1 Discussion

The screening criteria that were considered during the initial screening process are the location of facilities relative to seismic hazard zones, quaternary fault zones, and flood zones. Sites that were located in regions with seismic hazard areas (i.e., areas where there is a 10% chance of an earthquake generating a Peak Ground Acceleration equal to or greater than 10 percent g within any 50-year period) were excluded from further consideration, as were sites that could be impacted by quaternary fault movements and sites that were located in 500-year flood zones.

2.2.3.2.2.2 Eliminated Sites

Based on at least one of the three initial screening criteria described above, the following three candidate sites fall into an increased risk zone for the region and were eliminated for further consideration for the Proposed GLE Facility:

- **Columbia, SC** – Eliminated because, according to the USGS seismic hazard map, the site is in an area that has a 10% probability that a peak acceleration of approximately 10 percent g will be exceeded in any given 50-year time frame (USGS, 2005a).
- **Metropolis, IL –** Eliminated because, according to the USGS seismic hazard map, the site is located in an area that has a 10% probability that a peak acceleration of approximately 30 percent g will be exceeded in any given 50-year time frame (USGS, 2005a).
- **Paducah, KY –** Eliminated because, according to the USGS seismic hazard map, the site is located in an area that has a 10% probability that a peak acceleration of approximately 30 percent g will be exceeded in any given 50-year time frame (USGS, 2005a).

The locations of all candidate sites relative to the seismic hazard zones are displayed in **Figure 2.2-3**. Locations of sites relative to quaternary faults are shown in **Figure 2.2-4**. The results of the initial screening step are summarized in **Table 2.2-4**.

2.2.3.2.3 Coarse Screening

2.2.3.2.3.1 Discussion

The coarse-screening criteria were based on business factors relating to the requirements of the property size or potential difficulties in the transfer of property ownership.

Under the *Insufficient Land Availability* criterion, a site must be at least 100 acres (40 ha) in size to be considered.

The criterion *State-, County-, or Federally Owned Sites* anticipates delays in the potential acquisition of real property with state, county, or federal ownership, and therefore eliminated such sites.

The *Litigated Sites/High Potential For Local Or Regional Political Opposition* criterion eliminated sites under past, current, or anticipated litigation and sites that have a history of political opposition because these factors could significantly delay purchasing those sites and transferring ownership or obtaining necessary regulatory approvals.

CERCLA Superfund sites and RCRA Corrective Action Facilities sites are eliminated because of the anticipated difficulties associated with potential purchase and transfer.

A given site may be eliminated on the basis of multiple criteria.

2.2.3.2.3.2 Eliminated Sites

Based on at least one of the four coarse-screening criteria described above, the following 16 sites were eliminated from further consideration for the Proposed GLE Facility.

Insufficient Land Availability

- **Erwin, TN** – The property size is 66 acres (27 ha) and does not meet the minimum 100-acre (40-ha) requirement.

Government-Owned Sites (County, State, or Federal)

- Sites owned by the Tennessee Valley Authority:
  - Bellefonte, AL
  - Clinch River, TN
  - Hartsville, TN
  - Phipps Bend, TN
  - Yellow Creek, MS
- Sites owned by DOE:
  - Oak Ridge, TN
  - Portsmouth/Piketon, OH
  - Savannah River, SC
- Sites owned by a state or county:
  - Barnwell, SC
  - Sterling, NY.

Litigated Sites/High Potential for Local or Regional Opposition

- **Bailly, IN –** Plans to build the Bailly nuclear power plant were cancelled in 1981 due to concerned citizen opposition, which was followed by a lawsuit and costly delays. This was considered as an unfavorable condition for completion of the license application process within the GLE project schedule.
- **Forked River, NJ** – Because of state and local opposition to the re-licensing of Oyster Creek and pending NRC and federal court litigation, opposition to an enrichment facility is anticipated.
- **Marble Hill, IN** – The construction permit for a nuclear power plant at this site was canceled in 1985 due to cost overruns and strong local opposition, including litigation. This represents a disincentive to selection of the site.
- **Midland, MI** – The construction permit for a nuclear power plant at this site was canceled in 1986, partially due to protracted NRC and federal court litigation. The partially constructed plant was later converted into a natural gas-fired, combined-cycle cogeneration facility. As recent litigation in the region indicates, there is still potential for significant opposition to new nuclear projects. For example, one public interest group recently filed a lawsuit in a federal appeals court challenging the Palisades nuclear plant's on-site spent fuel storage plans.

CERCLA Superfund Sites and RCRA Corrective Action Facilities

- RCRA Corrective Action Facilities
  - Lynchburg, VA
  - Portsmouth/Piketon, OH.
- CERCLA Superfund NPL Sites
  - Oak Ridge, TN
  - Savannah River, SC.

The results of the coarse screen are summarized in **Table 2.2-5**. Three sites passed the coarse screen:

- Cherokee, SC
- Morris, IL
- Wilmington, NC.

2.2.3.2.4 Site Reconnaissance

The three sites that passed the coarse screen (Cherokee, SC; Morris, IL; and Wilmington, NC) were further evaluated in a site-reconnaissance step. The purpose of this step was to identify potential issues beyond the initial and coarse screening. GLE site-selection team members evaluated each site during on-site visits to identify any additional Go/No Go criteria.

The following factors were considered at each site:

- Additional planned land use
- Physical layout of existing facilities and infrastructure
- Discussion with site management and employees about current and future operations
- Parallel construction activities that might interfere with the planned facility
- Observed adjacent properties for potential complications.

The site visit at Cherokee, SC, identified significant ongoing demolition and construction activities. Consequently, the property owners were contacted regarding the potential availability of sufficient land to accommodate the Proposed GLE Facility (i.e., 100 acres [40 ha]). Duke Energy, the owner of the Cherokee site (now called the William States Lee III Nuclear Site) indicated that its plans for that site do not include any additional facilities beyond those currently contemplated by Duke (i.e., the proposed Lee Nuclear Station, Units 1 and 2). On December 13, 2007, Duke Energy submitted a combined construction and operating license application to the NRC for the proposed two-unit nuclear station at the Cherokee, SC, site. Based on the unavailability of an adequate portion of the site for the Proposed GLE Facility, the Cherokee, SC, site was eliminated.

2.2.3.2.5 Fine Screening

The two sites (Morris, IL, and Wilmington, NC) that remained after the site reconnaissance step entered the fine screening. The evaluation to support the fine-screening step for these two sites included the 889-acre (356-ha) GE property near Morris, IL, and the 1621-acre (656-ha) GE property near Wilmington, NC (geographically referred to herein as the Morris Site and Wilmington Site, respectively, unless otherwise noted). The results of the fine-screening step are described below.

2.2.3.2.5.1 Criteria-Weighting Results

In the criteria-weighting step, criteria underwent a pairwise comparison throughout the criteria hierarchy to determine the importance of criteria relative to each other. Below is a brief discussion regarding the weights assigned to the four criteria clusters.

There are four criteria clusters: *Impacts to the Environment*; *Impacts to the Facility*; *Impacts to Cost and Schedule*; and *Employment and Stakeholders*. Each of these criteria clusters is very important to the facility siting decision; therefore, there are only small differences in the weights assigned to the individual clusters.

Impacts to the Environment and *Impacts to the Facility* are given slightly greater weight than the weight given to the other two clusters. The reason for this is that these clusters include criteria important to public health and safety, community welfare, natural resources, and viability of the Facility. Criteria included in the *Impacts to the Environment* cluster are important for protection of individuals, communities, and the environment, as well as ultimately important for the long-term sustainability of the Facility. Therefore, this cluster is given greater weight than *Impacts to the Facility*. The slightly lower weight assigned to the *Impacts to the Facility* cluster reflects the fact that the Facility would be built in conformance with state and federal regulations to withstand meteorological and geological events, and the likelihood of adverse impacts to Facility operations or to the surrounding community and environment is low.

Impacts to Cost and Schedule and *Employment and Stakeholders* were weighted slightly lower than the other two clusters because the criteria in these clusters are primarily economic in nature and primarily impact the financial vitality of the Facility. *Impacts to Cost and Schedule* and *Employment and Stakeholders* have an essentially equal potential for economic impacts during construction, operation, and decommissioning of the Facility; therefore, these criteria are weighted equally.

The weighting results are listed below and are shown at the highest hierarchy level — the cluster level. Within each cluster, the criteria groups are listed in the order of their importance.

Cluster III – *Impacts to the Environment Weighting score: 0.27*

1. Public health and safety
2. Socioeconomic impacts
3. Ecology
4. Water resources

5. Air quality
6. Noise
7. Historic and archeological sites
8. Visual impacts.

Cluster II – *Impacts to the Facility Weighting score: 0.25*
1. Geologic hazards
2. Co-located or nearby hazardous land uses
3. Meteorology and climatology
4. Wildfires.

Cluster I – *Impacts to Time and Cost Weighting score: 0.24*
1. Contamination
2. Existing infrastructure
3. Co-location
4. Site physical characteristics
5. Site development.

Cluster IV – *Employment and Stakeholders Weighting score: 0.24*
1. Stakeholder support
2. Labor force.

The weighting scores are displayed in **Figure 2.2-5**.

2.2.3.2.5.2 Site Ranking Results

After the weighting step, the same criteria were used in the ranking process. The two sites that entered the fine-screening step were ranked based on site-specific data for each criterion. For the sake of brevity, only those criteria that had a significant impact on the site-selection outcome are discussed below. Some criteria did not have a significant impact on the final outcome because either 1) the specific criterion was weighted low relative to other criteria and did not influence the final outcome as much as criteria that were weighted higher, or 2) for some criteria, there was no significant difference in ranking between the two sites. The following section discusses only key criteria for each cluster that differentiated the sites and contributed towards the overall outcome.

Results are presented below at the highest hierarchy level, which is the cluster level **(**see also **Figure 2.2-6)**.

Cluster I – Impacts to Time and Cost. With respect to impacts to cost and schedule, the Wilmington Site received a score of 0.622, whereas the Morris Site received a score of 0.378. The Wilmington Site was scored 39% higher than the Morris Site.

The key factors that contributed to this ranking were the presence of existing infrastructure in Wilmington and co-location with other nuclear facilities at both sites. The existing GE/GNF-A facility in Wilmington provides a significant portion of the infrastructure requirements for constructing and operating the Proposed GLE Facility. Because the Wilmington Site is co-located with an existing nuclear fuel facility, there is an existing 10 CFR 70 license that could be leveraged for the Proposed GLE Facility. The presence of existing infrastructure decreases the cost and shortens the schedule for constructing the Proposed GLE Facility. On the other hand, the Morris Site is co-located with the Dresden Nuclear Power Plant, and because of this, there is a potential for complexities regarding emergency response planning.

Cluster II – Impacts to the Facility. With respect to impacts to the Facility, the Morris Site received a score of 0.592, whereas the Wilmington Site received a score of 0.408. The Morris Site was scored 31% higher than the Wilmington Site.

The key factor considered in this cluster was a comparison of relative susceptibility of the Morris Site and the Wilmington Site to potential geologic hazards. In the initial screening, candidate sites that were located in areas of higher risk of seismic or tectonic hazards were eliminated. These hazards were defined as quaternary fault zones or areas where there is a 10% probability in 50 years of groundshaking exceeding 10 percent g. The sites entering the fine screening were therefore considered to be in areas where earthquakes with a 10% probability of exceeding 10% groundshaking in 50 years are less likely to occur. Further, detailed comparisons were then made in the fine screening to quantify the seismic risk between the two sites by evaluating the probability of occurrence of a damaging earthquake, which is defined as an earthquake of magnitude 4.75 (Modified Mercalli Intensity Value of approximately 6). In addition to the magnitude, distance to the source of the earthquake and the soil conditions at the site all influence the intensity and amount of groundshaking. These three factors were considered to evaluate the seismic risk for each of the sites. The probability for the occurrence of major seismic events is low at both sites (less than 2% at the Wilmington Site, and less than 4% at the Morris Site); hence, the differences between these sites with regard to the geologic and seismic criteria are incremental. Although the probability for a high-magnitude earthquake is low at either site, there is a slightly higher potential for damage at the Wilmington Site due to the potential for amplification as a result of the presence of unconsolidated materials in the Coastal Plain. Therefore, overall, the Morris Site scored higher for this cluster.

Cluster III – Impacts to the Environment. With respect to impacts to the environment, the Wilmington Site received a score of 0.516, whereas the Morris Site received a score of 0.484. The Wilmington Site was scored 6% higher than the Morris Site.

Several key factors contributed to this preference, including impacts to the quality and quantity of surface water and groundwater resources; factors affecting air quality; direct and indirect impacts to public health; direct and indirect impacts to sensitive ecological species and habitat; and socioeconomic factors.

The potential impacts to water resources at the Wilmington Site were less than at the Morris Site. The groundwater system is the primary source of water in both locations and is currently stressed because of overuse of the deep bedrock aquifer system in the vicinity of the Morris Site. In addition, the groundwater at the Morris Site is more vulnerable to water quality impacts due to shallower and fractured rock than at the Wilmington Site.

Under normal operating conditions, there are negligible releases of materials from the Facility. Nevertheless, the air dispersion factors that influence ground-level concentration of any released material were evaluated at both sites. Based on historical data, the Morris Site generally experiences favorable atmospheric conditions for air dispersion of potential gaseous releases more often than the Wilmington Site.

Based on an analysis of a hypothetical worst-case, non-routine release of contaminants, the areas surrounding both sites that are likely to receive the highest direct impacts contain low populations and no sensitive receptors, and the potential for direct impacts to public health and safety is relatively low.

The National Land Cover Database (NLCD) was used to determine land cover in the vicinity of the sites. The area surrounding the Morris Site has a large percentage of agricultural lands; therefore, it has a larger number of potential indirect exposure pathways than the Wilmington Site.

Based on documented locations of species (including historical references), there are no potential direct impacts to Endangered, Threatened, rare, or regionally important plant or animal species at either portions of the Morris or Wilmington sites that were considered for the 100-acre (40-ha) Proposed GLE Facility. Aerial imagery and a review of state environmental databases show that there is slightly more habitat for Endangered and Threatened Species at the Wilmington Site than at the Morris Site.

Socioeconomic impacts addressed more than one key criterion. First, while there is a higher proportion of low-income or minority populations within 5 miles (8 km) of the Wilmington Site than for the same area around the Morris Site, the Census Block Groups immediately adjacent to either site do not contain high percentages of low-income or minority populations. For this reason, it was determined that such populations would not incur a disproportionate share of environmental impacts. Second, with regard to impacts on social infrastructure, it was determined that the social infrastructure at Wilmington has better capacity to better absorb the estimated influx of population required for constructing and operating the Facility than the social infrastructure at Morris. Third, regarding economic impacts, based on projected population and estimated wages of workers, the increase in tax base was predicted to be higher at the Wilmington Site than at the Morris Site.

Cluster IV – Employment and Stakeholders. With respect to employment and stakeholders, the Wilmington Site received a score of 0.561, whereas the Morris Site received a score of 0.439. The Wilmington Site was scored higher than the Morris Site by 22%.

The community and governments are supportive of the Facility at both the Morris and Wilmington sites, based on initial meetings with officials in North Carolina and the good standing of the current Facility with the Wilmington community, as well as prior responses earlier in 2007 from local stakeholders in Illinois relating to similar proposed actions at the Morris Site. The labor conditions at the Wilmington Site, including prevailing wage rates and labor availability, are more favorable than at the Morris Site.

Stability of Ranking Results. The ranking resulted in an overall score of .525 for the Wilmington Site and a score of .475 for the Morris Site. To verify the stability of the overall ranking result and its responsiveness to changes to the assigned weights, each cluster weight was individually varied by 10% using tools built into the software. It was observed in each case (Cost and Schedule, Impacts to the Facility, Impacts to the Environment, and Employment and Stakeholder Support) that there was no change in the overall result. This indicates that the results are relatively insensitive to minor perturbations in the weight.

2.2.3.3 Qualitative Cost-Benefit Analysis Results

Both the Morris Site and the Wilmington Site had advantages as potential locations for the Proposed GLE Facility. Comparing the two sites across all the criteria, it was concluded that the net benefits of locating the Facility in Wilmington were expected to be slightly higher than those associated with locating it in Morris. This is due to both somewhat lower private costs (due to lower labor costs in Wilmington and the fact that a GE/GNF-A facility that is a customer for the Proposed GLE Facility is co-located, thus reducing transportation costs and potential risks). In addition, the economic impacts (positive) would be slightly higher in Wilmington, and the social impacts (negative) would be somewhat lower. Although the Wilmington area has a more diverse population (and thus a larger percentage of minority and low-income individuals), the analysis did not indicate that minority or low-income populations would disproportionately experience adverse human health or environmental impacts as a result of the Proposed Action.

It was concluded that the Wilmington Site is a slightly preferable location based on the CBA results.

2.2.3.4 Conclusions

Based on the results of the site-selection process, GLE concluded that the Wilmington Site is the preferred site for the Proposed GLE Facility. Beginning with 22 candidate sites, 20 of those sites were eliminated during rigid initial-, coarse-, and reconnaissance-screening steps. The subsequent fine-screening step resulted in the proposed site, Wilmington, NC, ranking slightly higher than the Morris, IL, site by 9.5% (the Wilmington Site received a score of .525, and the Morris Site received a score of .475). In addition, the qualitative CBA indicated that the Wilmington Site would have slightly greater net benefits.

Even though the overall scoring from the fine-screening step and the results of qualitative CBA did not reveal significant differences between the two sites, there are several key factors that explain why the Wilmington Site scored higher than the Morris Site. Regarding impacts to time and cost, the existing on-site nuclear infrastructure at the Wilmington Site resulted in a higher score. With respect to impacts to the environment and employment and stakeholder support, the Wilmington Site also scored higher (6% and 22%, respectively). Environmental impacts to the quality and quantity of surface water and groundwater resources, meteorological conditions that impact air quality, direct and indirect impacts to sensitive ecological species and habitat, and adverse socioeconomic impacts were less severe at the Wilmington Site, resulting in a higher scoring. With respect to employment and stakeholder support, the market conditions at Wilmington provided cost savings compared with the market conditions at Morris. The higher score for the Morris Site regarding impacts to the Facility (31%)—primarily a result of the higher susceptibility of the area to seismic hazards—was not significant enough to offset the higher Wilmington scores in the other cluster areas.

The qualitative CBA substantiated the overall fine-screening score and revealed that the economic impacts (positive) would be slightly higher in Wilmington, whereas the social impacts (negative) would be somewhat lower.

The results of the site-selection process are summarized in **Figure 2.2-7**.

2.2.4 Elimination of Facility Location Alternatives at Wilmington Site

The Main portion of the GLE Study Area (the 209-acre [85-ha] portion shown in **Figure 1-3**) was selected, in part, because it is a contiguous tract of undeveloped land on the Wilmington Site with sufficient acreage to accommodate the Proposed GLE Facility, which will require approximately 100 acres (40 ha). Furthermore, it was initially identified, based on professional judgment, as being less susceptible to adverse environmental impacts than other available areas of the Wilmington Site. Specifically, GLE recognized that the area is an elevated portion of the Site located above the floodplain of the Northeast Cape Fear River. GLE also observed that it contained neither streams nor any readily apparent wetlands or rare ecological resources. GLE further noted that cultivation is likely the only prior land use of the Main portion of the GLE Study Area and that it probably involved draining of the area via ditches that were constructed prior to GE's acquisition of the property and subsequent planting of pine forest. As confirmed by the detailed assessment undertaken to support this Report, locating the proposed facility on the GLE Study Area avoids significant environmental impacts. Alternative locations within the Wilmington Site were considered, but were eliminated from further evaluation because they are too small to accommodate the Proposed GLE Facility or are located near floodplains, streams, and/or readily apparent wetlands or rare ecological resources that would likely require a significant degree of mitigation. For these reasons, GLE concluded that the Main portion of the GLE Study Area is the optimal location for the Facility within the Wilmington Site.

2.3 Cumulative Effects

Cumulative impacts are impacts that result from the incremental impact of an action added to other actions. These other actions can include past, current, or foreseeable future actions. Past, current, and reasonably foreseeable future industrial and non-industrial activities were evaluated for potential cumulative impacts when combined with the Proposed Action:

- **Cumulative effects across lifecycle phases.** These are cumulative impacts resulting from activities during construction, operation, and/or decommissioning at the Proposed GLE Facility.
- **Cumulative effects across resources.** These are impacts from activities that can impact more than one resource (e.g., increased truck traffic impacts air quality and can also impact traffic congestion and noise patterns, thus creating a cumulative effect).
- **Cumulative effects with other on-site or off-site adjacent facilities or activities.** Facility activities that may result in cumulative effects with the activities of the Proposed GLE Facility, such as
  - **Existing projects at the Wilmington Site.** The current FMO facility and other existing Wilmington Site facilities are considered in the evaluation of cumulative impacts.
  - **Additional projects planned for the Wilmington Site.** Two construction activities planned on the Wilmington Site and described below are the Advanced Technology Center (ATC) II complex and the Tooling Development Center. The addition of these projects has the potential to result in cumulative impacts with the Proposed GLE Facility.
  - **New process planned for the Wilmington Site.** The industrial re-use of treated sanitary wastewater effluent as process water for the Wilmington Site facilities is further discussed below.
  - **Off-site industrial development.** Most of the industrial development in the vicinity of the Wilmington Site is on the west side of the Northeast Cape Fear River. No new industrial developments are known to be planned in the immediate vicinity of the Wilmington Site on the east side of the river. Outside the 5-mile [8-km] radius of the Wilmington Site in the unincorporated northeastern portion of New Hanover County, the Carolinas Cement Company LLC (a subsidiary of Titan America LLC) has submitted an air permit application (Carolinas Cement Company, 2008) to construct a new cement manufacturing plant on an approximately 1,868-acre (749-ha) parcel that includes undeveloped forest lands, an existing cement storage terminal, and the active sand and gravel quarry currently operated by Martin Marietta Materials (the Castle Hayne Quarry shown on **Figure 3.1-14** in **Section 3.1** of this Report, *Land Use*). The U.S. Army Corps of Engineers (USACE) has published in the Federal Register a Notice of Intent to prepare a draft Environmental Impact Statement for the project (USACE, 2008). Additional details about this proposed project are presented in various sections of **Chapter 4** of this Report (*Environmental Impacts*) as they relate to the individual technical disciplines evaluated for cumulative impacts.
  - **Off-site residential development.** A developer is proposing a new 237-acre (95-ha) continuing care retirement community (River Bluffs subdivision) that would be built on the undeveloped land parcel bounded by the Wilmington Site's southern property line, I-140, and the Northeast Cape Fear River (New Hanover County Planning Board, 2008).
  - **Off-site UF_6 transportation.** This can result in the cumulative radioactive dose to the general public from the transportation of UF_6 as feed, product, or depleted material and solid waste.

The ATC II complex will be located adjacent to the existing ATC I building in the southeastern portion of the Eastern Site Sector, near the Wilmington Site's South Gate entrance. The entire project will disturb approximately 30 acres (12 ha) of the Wilmington Site. In preparation for the new office complex, a stormwater wet detention basin has already been constructed on the Site, and a new parking lot and a set of temporary trailers have been set up in front of the existing ATC I building. The temporary trailers will serve as offices until the new complex is completed. There will be no effluents from these activities aside from those associated with construction and sanitary waste. The complex will require an estimated 7,500 gallons per day (gpd; 28,400 liters per day [lpd]) of potable water, and it is conservatively assumed that there will be no consumptive losses and the same volumes of sanitary wastewater would be generated for treatment in the existing Wilmington Site sanitary wastewater treatment facility.

The Tooling Development Center will be located in the southwestern portion of the Eastern Site Sector. It will consist of 5 new buildings and will disturb approximately 30 acres (12 ha) of the Wilmington Site. The Center will require an estimated 5,000 and 11,000 gpd (18,900 and 41,600 lpd) of process water and potable water, respectively. It is conservatively assumed that there will be no consumptive losses of water from the Center and that the same volumes of process and sanitary wastewaters would be generated for treatment in the existing Wilmington Site final process lagoon facility and sanitary wastewater treatment facility, respectively. No radioactive material will be used in the Tooling Development Center buildings, and no air permits will be required. Approximately 0.75 miles (1.2 km) of new road will be constructed in the Eastern Site Sector in order to access the center.

The Wilmington Site sanitary wastewater treatment facility has recently been upgraded and, along with securing a re-use permit from NCDENR, these renovations enable the industrial re-use of treated sanitary wastewater effluent as make-up water in Wilmington Site cooling towers. This effluent re-use process resulted in the switch away from discharge of treated sanitary wastewater effluent to the effluent channel, which flows to Unnamed Tributary #1 to Northeast Cape Fear River (Waters of the United States). The NPDES discharge permit remains valid should discharges of treated sanitary wastewater become necessary in the future. Although this effluent re-use process commenced in April 2008, the effects of this process are considered in the cumulative impacts assessments because the process postdates the 2006 baseline set of conditions presented in **Chapter 3** of this Report (*Description of the Affected Environment*). Once the Proposed GLE Facility, ATC II complex, and Tooling Development Center are operating, approximately 62,300 gpd (235,800 lpd) of sanitary wastewater effluent generated by the wastewater treatment facility would be used for process operations. This industrial re-use volume of 62,300 gpd (235,800 lpd) is based on the existing sanitary wastewater discharge of 33,300 gpd (124,900 lpd), a projected sanitary wastewater discharge from the Proposed GLE Facility of 10,500 gpd (39,700 lpd), and the estimated sanitary wastewater discharges for the ATC II complex and the Tooling Development Center discussed above. Because the treated sanitary wastewater effluent has such low hardness, its addition to the Wilmington Site cooling towers increases efficiencies. Each gallon of re-use water introduced into a cooling tower offsets two gallons of process make-up water. Therefore, once the Proposed GLE Facility, ATC II complex, and Tooling Development Center are operating, this effluent re-use process will reduce groundwater withdrawal for process-water requirements by approximately 124,600 gpd (471,700 lpd) (i.e., twice the projected cumulative sanitary wastewater treatment rate of 62,300 gpd [235,800 lpd]) and will reduce the amount of process water to be treated in the final process lagoons and discharged to Waters of the United States by approximately 62,300 gpd [235,800 lpd]).

The standard of significance established by the NRC in NUREG-1748 was used to define impacts as follows:

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

- **LARGE.** The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The cumulative impacts of the facilities and actions described above combined with the Proposed Action are summarized on **Table 2.3-1**, and overall, these impacts are anticipated to be SMALL. To measure the overall effect of the Proposed Action, aggregate benefits and aggregate costs 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. The benefits conveyed include increased energy security for the United States because of increased supply of enriched uranium; reduced air pollution through enabling the substitution of nuclear power generation in place of fossil-fuel-based power generation; increased employment and income for residents of the Wilmington region; and income and revenues generated by the operation of the Proposed GLE Facility. Some of these benefits would be expected to be LARGE. Environmental costs, including transportation impacts, water use and water quality impacts, ecological impacts, and air emission impacts, would be generally SMALL and mitigated.

2.4 Comparison of the Reasonably Foreseeable Environmental Impacts

As described in **Section 2.2**, evaluations have been performed for alternatives to the Proposed Action regarding technology, Facility design, site location, and Facility location, and the results of these evaluations have eliminated these alternatives from further consideration. Therefore, the comparison presented in this Report is that of the Proposed Action, under which the Proposed GLE Facility would be constructed and would generate an initial 6 million SWU while minimizing potential adverse environmental impacts, against the No Action Alternative, under which the Proposed GLE Facility would not be constructed. Reasonably foreseeable environmental impacts and the extent of those impacts from the Proposed Action, potential mitigation measures, and restoration actions, if applicable, are described in detail in the resource-specific sections of **Chapter 4** of this Report (*Environmental Impacts*), as well as summarized in **Section 2.1.2.2**. **Table 2.4-1** shows the comparison between the potential impacts for the Proposed Action and the No Action Alternative with regard to domestic capacity and supply. **Table 2.1-1** presents a summary of the potential environmental impacts of the Proposed Action as compared against the No Action Alternative.

Tables

Table 2.1-1. Comparison of the Reasonably Foreseeable Environmental Impacts from the Proposed Action and the No Action Alternative

Environmental Category	Proposed Action	No Action Alternative
Land Use	**SMALL** – A uranium-enrichment facility would be constructed and operated on a General Electric Company (GE)–owned land parcel that is currently zoned for I-2 for Heavy Industrial land use and already serves as a site for nuclear fuel manufacturing operation (FMO) and other industrial manufacturing operations. The Proposed GLE Facility would be decontaminated and decommissioned so as to be acceptable for unrestricted use.	**SMALL** – A uranium-enrichment facility would not be added to the Wilmington Site.
Transportation	**SMALL to MODERATE** – Construction and operation of the Proposed GLE Facility would add to the motor vehicle traffic volumes (estimated increases of 815 to 1,560 average daily trips [ADT]) on segments of N.C. Highway 133 (also known as Castle Hayne Road) in the immediate vicinity of the Wilmington Site and increase the potential for traffic congestion during peak commuting hours; therefore, the transportation impacts on a local basis would be MODERATE. The proximity of the Proposed GLE Facility to the NC 133/U.S. Interstate Highway 140 (I-140) interchange and direct connection of I-140 to U.S. Interstate Highway 40 (I-40) would allow truck shipments and workers commuting to and from the Proposed GLE Facility to bypass traveling on surface roadways in the surrounding communities; therefore, the transportation impacts for the Proposed GLE Facility on a regional basis would be SMALL.	**SMALL** – Additional motor vehicle traffic would not be added to the levels associated with the existing Wilmington Site facilities. Existing uranium hexafluoride (UF_6) radioactive source-material, product, and waste transport related to the existing FMO would remain the same.

(continued)

Table 2.1-1. Comparison of the Reasonably Foreseeable Environmental Impacts from the Proposed Action and the No Action Alternative (continued)

Environmental Category	Proposed Action	No Action Alternative
Soils and Geology		
▪ Site Soils	**SMALL** – Due to existing slope gradients less than 2% across the Main portion of the 100-acre (40-hectare[ha]) GLE Study Area, minimal terrain changes would be required during site preparation to accommodate the Proposed GLE Facility. Including an additional 13 acres (5 ha) for ancillary structures located to the east of the 100-acre (40 ha) parcel and within the Main portion of the GLE Study Area, and approximately 33 acres (13 ha) of the North Road portion of the GLE Study Area, a total area of approximately 146 acres (59 ha) of shallow soil would be disturbed. This soil would be either reused within the GLE construction site (i.e., GLE Facility site) or stockpiled for potential use in other areas of the Wilmington Site. Impacts from decommissioning are expected to be SMALL since any potential contaminated soil would be removed to meet U.S. Nuclear Regulatory Commission (NRC) and U.S. Environmental Protection Agency (EPA) requirements.	**SMALL** – No soil disturbance and road improvements within the GLE Study Area would be necessary. Therefore, approximately 146 acres (59 ha) would remain undisturbed in the foreseeable future.
▪ Geology[a]	**SMALL** – Potential geologic impacts to the Proposed GLE Facility (e.g., differential settlement, seismic-induced liquefaction) would be controlled by engineering designs to meet building code requirements.	**SMALL** – There would be no other facility constructed in the GLE Study Area that would be impacted as a result of geological factors.

(continued)

Table 2.1-1. Comparison of the Reasonably Foreseeable Environmental Impacts from the Proposed Action and the No Action Alternative (continued)

Environmental Category	Proposed Action	No Action Alternative
Water Resources		
▪ Groundwater Quality	**SMALL** – With the addition of the Proposed GLE Facility, the quality of the National Pollutant Discharge Elimination System, (NPDES)–permitted Wilmington Site effluents would be of similar quality as compared to current effluents. Therefore, the impacts on groundwater quality from any small amount of effluent that might infiltrate to the aquifer are anticipated to be SMALL. Stormwater runoff from the Proposed Action would drain to a stormwater wet detention basin designed with a clay liner and installed according to standard engineering construction and quality assurance practices to avert infiltration. Further, no more than trace levels of radiological constituents would be anticipated to be released from the Proposed GLE Facility to the stormwater wet detention basin considering the procedures that would be in place for managing and monitoring stormwater from the UF_6 storage pad areas. Therefore, groundwater quality impacts from stormwater are anticipated to be SMALL. In addition, the potential for groundwater radiological impacts from any unanticipated releases of Proposed GLE Facility process water are anticipated to be SMALL, considering the management and pre-treatment procedures to be implemented. Potable and process water would be provided by the existing groundwater supply well system used at the Wilmington Site. The changes in pumping would only induce a small change in groundwater elevations. This change is not anticipated to have any impact on off-site groundwater quality, and no anticipated significant impact on the effectiveness of the existing on-site pumping well system to protect off-site groundwater users from existing on-site impacted groundwater is anticipated. During site preparation, construction and decommissioning, best management practices (BMPs) would be implemented to prevent impacts to groundwater quality.	**SMALL** – Groundwater conditions would remain unchanged under the No Action Alternative; therefore, impacts to groundwater quality would not be anticipated.

(continued)

Table 2.1-1. Comparison of the Reasonably Foreseeable Environmental Impacts from the Proposed Action and the No Action Alternative (continued)

Environmental Category	Proposed Action	No Action Alternative
▪ Surface Waters	**SMALL** – Construction and operation of the Proposed GLE Facility and proposed North and South access roads would not cause water quality standards or limits to be exceeded. The Proposed GLE Facility would not require the consumptive use of any surface water. Impacts to navigation, industrial transport, commercial fishing, or recreation uses would be SMALL. Over the decommissioning phase, sanitary and process wastewater effluent discharges would incrementally decrease to zero, and stormwater runoff would flow to the existing GLE stormwater wet detention basin.	**SMALL** – Stream crossings by new roads, new construction, or improvements to the existing facility would not occur. Direct or indirect impacts to surface waters would not be expected.
▪ Floodplains	**SMALL** – Upgrade of the stream crossing of the existing service road within the South Road portion of the GLE Study Area over Unnamed Tributary #1 to Northeast Cape Fear River would occur within the floodplain boundary, but the new crossing would be designed to meet or exceed current flow capacity. Therefore, impacts to the floodplain would be SMALL. No other direct modifications to the boundaries of the floodplains are expected because construction, operation, and expected decommissioning activities would occur outside of the floodplain boundaries. Any increase in floodwaters due to stormwater runoff from the Proposed GLE Facility would be SMALL and likely mitigated by the natural buffering capacity of the Swamp Forest of the Western Site Sector.	**SMALL** – The No Action Alternative would not involve any grading or other modification of the terrain on the Site, nor would it affect stormwater runoff quantity.
▪ Wetlands	**SMALL** – The site preparation and construction of the Proposed Action would impact up to 0.42 acres (0.17 ha) of jurisdictional wetlands and 0.19 acres (0.07 ha) of isolated wetlands. These impacts would be mitigated for in accordance with State and federal permits; therefore, direct loss of wetlands would be SMALL. Indirect impacts to wetland quality from sedimentation and loss of vegetation would be temporary and SMALL and would be mitigated by restoration. Indirect impacts during operation would occur to wetlands that would receive stormwater runoff from the Proposed GLE Facility. These impacts are expected to be SMALL. There would be no further impacts from the decommission phase.	**SMALL** – There are currently approximately 660 acres (267 ha) of undrained wetlands on the Wilmington Site. The No Action Alternative would not involve new road crossings, new construction, or improvements; therefore, direct or indirect impacts to wetlands would not be expected.

(continued)

Table 2.1-1. Comparison of the Reasonably Foreseeable Environmental Impacts from the Proposed Action and the No Action Alternative (continued)

Environmental Category	Proposed Action	No Action Alternative
▪ Water use	**SMALL** – Impacts to surface water uses are not anticipated. Process and potable water required for Proposed GLE Facility operations would be obtained from the existing Willington Site groundwater supply well system, and the changes in demand would induce relatively minor changes in groundwater elevations. Water use impacts during decommissioning are anticipated to be SMALL	**SMALL** – Water use conditions would remain unchanged under the No Action Alternative.
Ecological Resources	**SMALL to MODERATE** – Construction impacts on existing vegetation and local fauna are expected to be MODERATE because overall wildlife populations and forested biotic communities on the Wilmington Site would be altered, but would not destabilize the existence of these communities. The operation and decommissioning phases of the Proposed Action would not noticeably further impact the biotic communities or wildlife.	**SMALL** – Ecological conditions would remain unchanged.
Air Quality	**SMALL** – The Proposed GLE Facility would not be a major source of air emissions as defined by the applicable EPA and North Carolina Division of Air Quality (NC DAQ) air permitting requirements. The laser uranium enrichment technology would not emit carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), or volatile organic compounds (VOCs). There is a potential that Proposed GLE Facility operations could result in small releases of hydrogen fluoride (HF) and particulate matter (PM), consisting of uranium isotopes and uranyl fluoride (UO_2F_2). Any such releases would be contained within the main GLE operations building and routed to a high-efficiency, multi-stage emissions-control system. Additional CO, NO_x, PM, SO_2, and VOC emissions would be released from on-site vehicles and from automobiles and trucks travelling to and from the Facility. Air modeling studies predict that the air emissions to the atmosphere from the Facility's construction and operation air emissions sources would not substantially change the ambient air quality in the vicinity of the Proposed GLE Facility. The air emissions are expected to have no measurable impact on regional visibility.	**SMALL** – New air emission sources would not be added to the Wilmington Site. Air emissions sources for the existing Wilmington Site facilities would continue to operate according to the applicable emission limits and control requirements in the current NC DAQ air quality permits.

(continued)

Table 2.1-1. Comparison of the Reasonably Foreseeable Environmental Impacts from the Proposed Action and the No Action Alternative (continued)

Environmental Category	Proposed Action	No Action Alternative
Noise	**SMALL to MODERATE** – Construction and decommissioning of the Proposed GLE Facility would temporarily generate short duration noises, resulting in MODERATE noise level impacts to existing residents in proximity to the northeast Wilmington Site property line. At other farther off-site locations, the noise impacts would be SMALL. Operational noise levels would be below the applicable New Hanover County Noise Ordinance and EPA sound level limits.	**SMALL** – Existing average sound levels of 41–46 dBA are in compliance with the New Hanover County Noise Ordinance and would remain unchanged under the No Action Alternative.
Historical and Cultural Resources	**SMALL** – Impacts from paving and minor increased use of an existing gravel road adjacent to a discovered prehistoric archaeological site would be SMALL, and the archaeological site would not be disturbed by construction, operation, and decommissioning of the Proposed GLE Facility. No other historically significant archaeological sites were identified within the GLE Study Area.	**SMALL** – The No Action Alternative would leave existing conditions unchanged.
Visual/ Scenic	**SMALL** – The Proposed GLE Facility would be compatible with the Wilmington Site's Bureau of Land Management Visual Resources Management System (i.e., BLM VRMS) Management Class IV designation. The visual/scenic resource impacts of Proposed GLE Facility operations at viewpoints outside of the Wilmington Site property boundaries would be mitigated by the design and layout of buildings and other Proposed GLE Facility structures, their location on the Wilmington Site, and the retention of a perimeter tree buffer. The main GLE operation building and new water tower would be the only structures that are likely to have a visual impact to observers at some off-site viewpoints. Given the nature and scale of existing industrial manufacturing operations at the Wilmington Site and in its vicinity, adding these two additional tall structures to the Wilmington Site would not be out of character with the visual elements and architectural features already at the Site.	**SMALL** – Under the No Action Alternative, there would be no construction of the Proposed GLE Facility on the Wilmington Site. Consequently, the visual/scenic resources impacts would remain unchanged.

(continued)

Table 2.1-1. Comparison of the Reasonably Foreseeable Environmental Impacts from the Proposed Action and the No Action Alternative (continued)

Environmental Category	Proposed Action	No Action Alternative
Socioeconomics	**SMALL** – Overall population, economic, and social impacts from the Proposed GLE Facility are anticipated to be SMALL, even though individual impacts on housing, educational, medical, law enforcement, fire, and rescue services may vary.	**SMALL** – Under this alternative, existing population and employment baseline conditions in the three-county Study Area (Brunswick, New Hanover, and Pender counties) would not be impacted.
Environmental Justice	**SMALL** – The Proposed Action is not expected to result in disproportionately high or adverse impacts on low-income or minority residents.	**SMALL** – Under the No Action Alternative, the population of the region is expected to grow as projected by the North Carolina Demography Office, and the demographic characteristics of the population would remain unchanged from that baseline.
Public and Occupational Health	**SMALL** – During the site preparation and construction phase, worker activities and exposures to hazardous materials would be controlled and monitored according to Occupational Safety and Health Administration (OSHA) and applicable state construction site requirements. Any radiological and non-radiological impacts to worker or public health from operations would be SMALL. During decommissioning activities, worker radioactive and hazardous material exposures and potential release pathways to public exposure would be controlled and monitored according to GLE internal procedures, license conditions, and federal and State regulatory requirements in effect at the time of decommissioning. Impacts would therefore be SMALL.	**SMALL** – The No Action Alternative would not contribute any additional nonradiological or radiological emissions to the environment. Ongoing site activities would continue, and potential health impacts would be expected to remain unchanged.

(continued)

Table 2.1-1. Comparison of the Reasonably Foreseeable Environmental Impacts from the Proposed Action and the No Action Alternative (continued)

Environmental Category	Proposed Action	No Action Alternative
Waste Management	**SMALL to MODERATE** – Construction activities would not generate appreciable wastewater streams. Operational process liquid radwaste, treated radwaste effluent, other process wastewater, sanitary wastewater, and stormwater runoff would be collected, treated, and managed appropriately and within NPDES-permit conditions, as would be radioactive-contaminated solutions generated during the decommissioning phase. Municipal, industrial non-hazardous, and hazardous waste generated during Proposed GLE Facility construction, operation, and decommissioning would be collected and shipped off-site for recycling, treatment, and/or disposal at the appropriate, licensed facility. Low-level radioactive waste (LLRW) generated during Proposed GLE Facility operation and decommissioning would be collected and shipped off-site to a licensed LLRW disposal facility. UF_6 tails would be temporarily stored at the Proposed GLE Facility before being shipped to a licensed depleted-uranium conversion facility. The impacts from on-site UF_6 tails cylinders storage during normal conditions would be SMALL and, in the event of an accident, the impacts would be SMALL to MODERATE, depending on the type and magnitude of the incident. It is expected that the impacts of off-site conversion of the UF_6 tails generated by the Proposed GLE Facility to depleted uranium oxide at a licensed depleted-uranium conversion facility, and the ultimate disposal of this material at a licensed LLRW disposal facility, would be SMALL.	**SMALL** – Waste generation sources associated with uranium-enrichment operations would not be added to the Wilmington Site. Consequently, no waste streams would be added to those already generated and managed at the existing Wilmington Site facilities.

[a] Geological impacts are expressed as impacts *on* the Proposed Action and No Action Alternative rather than impacts *from* those actions on the environment. This is in accordance with NUREG 1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS (Nuclear Material Safety and Safeguards) Programs,* which states, "More likely, geological resources may exert an impact on the proposed action.…"

Table 2.1-2. Chemicals and Materials Identified for Use at the Proposed GLE Facility

Liquids	
Acetone	Nitrogen
Cable lubricant	Oxygen
Calcium gluconate gel	Paint
Coolant/oils	PFPE (fomblin) oil
Degreaser sludge	Plating solutions (e.g., Ni, Cu, Ag)
Diesel fuel	Potassium or sodium hydroxide
Ethanol	R123 refrigerant
Fomblin grease	R134a refrigerant
Fomblin oil sludge	RBS35 detergent
Fuel oil	Silicone grease
Gasoline	Sulfuric acid
General vacuum pump oil	Sulfuric acid batteries
Hexane	Transformer oil
Hydrofluoric acid	Uranium compounds
Nitric acid	Uranium hexafluoride
Gases	
Acetylene	Nitrogen
Argon	Oxygen
Butane	Propane
Carbon dioxide	R123 refrigerant
Carbon monoxide	R134a refrigerant
Helium	Sulfur hexafluoride
Hydrofluoric acid (hydrogen fluoride)	Uranium compounds
Hydrogen	Uranium hexafluoride
Solids	
Activated carbon	Sand-blasting sand
Aluminum oxide	Shot-blasting media
Calcium gluconate tablets	Sodium chloride
Fused potassium fluoride	Solder
Indium	Soldering paste
Ion exchange resin	Uranium compounds
Nickel alloy	Uranium hexafluoride
Phosphorus pentoxide	Zeolite

Table 2.2-1. Review of Siting Documentation

Study	Siting Type
Kirkwood, C.W. 1982. A case history of nuclear power plant site selection – the practice of decision analysis. *The Journal of the Operational Research Society 33*(4):353–363.	Nuclear power plant
LES (Louisiana Energy Services, L.P.). 1994. *Claiborne Enrichment Center Environmental Report*. Revision 15. Louisiana Energy Services, Claiborne Enrichment Center, Homer, LA. April 11.	Uranium-enrichment facility
Dames & Moore with Gilbert/Commonwealth. 1993. *Early Site Permit Demonstration Program. Siting Guide: Site Selection and Evaluation Criteria for an Early Site Permit Application*. Revision 1. Dames & Moore with Gilbert/Commonwealth, Inc.	Nuclear power plant
Entergy Nuclear. 2001. *Site Selection Criteria Guidelines for an Early Site Permit*. Entergy Corporation, Entergy Nuclear, Jackson, MS.	Nuclear power plant
Briassoulis, H. 1995. Environmental criteria in industrial facility siting decisions: an analysis. *Environmental Management* 19(2):297–311.	Industrial facility siting
Private Fuel Storage. 2001. *Environmental Impact Statement for the Construction and Operation of an Independent Spent Fuel Storage Installation on the Reservation of the Skull Valley Band of Goshute Indians and the Related Transportation Facility in Tooele County, Utah*. Private Fuel Storage, LLC, Salt Lake City, UT.	Spent nuclear fuel storage facility
USEC (United States Enrichment Corporation). 2006. *Environmental Report for the American Centrifuge Plant in Piketon, OH*. USEC, Inc., Bethesda, MD.	Gas centrifuge uranium-enrichment facility
Ford, C.K., R.L. Keeney, and C.W. Kirkwood. 1979. Evaluating methodologies: a procedure and application to nuclear power plant siting methodologies. *Management Science* 25(1):1–10.	Nuclear power plant
Wike, L.D., and J.A. Bowers. 1995. *Facility Siting as a Decision Process at the Savannah River Site*. Westinghouse Savannah River Company, Aiken, SC.	Various facility types
Duke, Cogema, Stone and Webster. 2000. *Mixed Oxide Fuel Fabrication Facility*. Environmental Report, Revision 1&2. Duke, Cogema, Stone and Webster, Charlotte, NC.	Fuel-fabrication facility
LES (Louisiana Energy Services, L.P.). 2004. *National Enrichment Facility, Environmental Report*. Louisiana Energy Services, National Enrichment Facility, Lea County, NM.	Gas centrifuge uranium-enrichment facility
Dominion Energy. 2002. *Study of Potential Sites for the Deployment of New Nuclear Power Plants in the United States*. Prepared by Dominion Energy, Inc., for the U.S. Department of Energy.	Nuclear power plant

Table 2.2-2. Review of Regulatory Framework

NRC Regulatory Guide 1.76 – *Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants* (NRC, 2007a)
NRC Regulatory Guide 3.25 – *Standard Format and Content of Safety Analysis Reports for Uranium Enrichment Facilities* (NRC, 1974)
NRC Regulatory Guide 4.7 – *General Site Suitability Criteria for Nuclear Power Stations* (NRC, 1998)
NRC Regulatory Guide 4.9 – *Plant Siting and Design Alternatives*
NRC Regulation 10 CFR 50 – *Appendix S to Part 50—Earthquake Engineering Criteria for Nuclear Power Plants*
NRC Regulation 10 CFR 70 – *Domestic Licensing of Special Nuclear Material*
NRC Regulation 10 CFR 100.23 – *Geologic and Seismic Siting Criteria*
NUREG-1520 – *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility—Final Report* (NRC, 2002)
NUREG-1555 – *Environmental Standard Review Plan*. Revision 1, July 2007 (NRC, 2007c)
NUREG-1748 – *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs* (NRC, 2003)
NUREG/CR-4461 – *Tornado Climatology of the Contiguous United States* (NRC, 2007d)

Table 2.2-3. Candidate Sites Considered

Site Name	Existing Nuclear Facility	Description	Owner/Operator
Bailly, IN	No	The site had a construction permit to build a nuclear power plant, which was cancelled in 1981. After long delays and growing local opposition, the Northern Indiana Public Service Company (NIPSC) ended the controversy by canceling plans to build the nuclear plant at the Bailly Site.	Northern Indiana Public Service Company (NIPSC)
Barnwell, SC	Yes	Low-level waste disposal facility.	State of South Carolina/Energy Solutions
Bellefonte, AL	Yes	Uncompleted nuclear power plant (in the Final Environmental Assessment, TVA, in 2006, reported that it approved the cancellation of the BLN construction project pending NRC notification). The BLN plant site now is under consideration as the location of an advanced boiling water reactor. In October 2007, TVA submitted a combined license application for proposed Bellefonte Nuclear Station Units 3 and 4.	Tennessee Valley Authority
Cherokee, SC	No	The site had a construction permit under review, which was cancelled 1982–1983. In December 2007, Duke Energy filed a combined license application for proposed Units 1 and 2 at the William States Lee III Nuclear Site (formerly called the Cherokee Site).	Duke Energy
Clinch River Industrial Site, TN	No	Clinch River Breeder Reactor project was cancelled in 1983. The 1,700-acre (687-hectares [ha])area is adjacent to the Clinch River, approximately 13 miles (21 kilometers [km]) west of Oak Ridge, and is partially developed and for sale by the Tennessee Valley Authority.	Tennessee Valley Authority
Columbia, SC	Yes	Active uranium fuel-fabrication facility	Westinghouse Electric Company
Erwin, TN	Yes	Active uranium fuel-fabrication facility	Nuclear Fuel Services, Inc.
Forked River, NJ	No	The site had a construction permit, which was cancelled in 1980. The 657-acre (266-ha) area is adjacent to the Oyster Creek Nuclear Generating Station (OCNGS).	AmerGen Energy Company, LLC
Hartsville, TN	No	The site had a construction permit, which was cancelled in 1982–1984. In August 2003, Louisiana Energy Services, L.P. (LES) ended efforts to build a uranium-enrichment facility in Tennessee (zoning approval issues due to local opposition to proposed facility).	Tennessee Valley Authority
Lynchburg, VA	Yes	Active uranium fuel-fabrication facilities. The Mount Athos site consists of the following facilities: the BWXT Nuclear Products Division (NPD) and AREVA NP. The NPD is a manufacturer of nuclear components for government agencies and the U.S. Department of Energy (DOE). In addition, the NPD operates a uranium-recovery facility and a uranium-downblending facility.	AREVA NP, Inc./ BWX Technologies, Inc.

(continued)

Table 2.2-3. Candidate Sites Considered (continued)

Site Name	Existing Nuclear Facility	Description	Owner/Operator
Marble Hill, IN	No	The site had a construction permit, which was cancelled in 1985 due to cost overrun. In 1998, PSI Energy sold the property to Debbie and Dean Ford, who sold some buildings to a Michigan company in 2005.	Debbie and Dean Ford
Metropolis, IL	Yes	Active uranium hexafluoride production (conversion) facility. 10-year license renewal was issued in May 2007.	Honeywell Specialty Chemicals/ConverDyn
Midland, MI	No	The site had a construction permit, which was cancelled in 1986. The unfinished Midland Nuclear Power Plant was converted to a combined-cycle, natural-gas-fired cogeneration facility.	MCV Power Partners, Inc.
Morris, IL	Yes	Spent-fuel storage facility. Near Dresden Reactors.	GE Company
Oak Ridge, TN	Yes	Nuclear research facility.	DOE
Paducah, KY	Yes	Gaseous-diffusion plant	DOE/U.S. Enrichment Corporation
Phipps Bend, TN	No	The site had a construction permit, which was cancelled in 1982. The reactor was demolished.	Tennessee Valley Authority
Portsmouth/ Piketon, OH	Yes	Existing gaseous-diffusion plant; gas centrifuge plant under construction.	DOE
Savannah River, SC	Yes	Nuclear materials processing center.	DOE
Sterling, NY	No	The site had a construction permit, which was cancelled in 1980. Adjacent to operational nuclear power plant (FitzPatrick, Oswego, NY). Cayuga County purchased the property in 1994 and opened the Sterling Nature Center.	Cayuga County
Wilmington, NC	Yes	Active uranium fuel-fabrication facility	GE Company
Yellow Creek, MS	No	The site had a construction permit, which was cancelled in 1984.	Tennessee Valley Authority

Table 2.2-4. Initial Screening Results

Site Name	Seismic Hazard Zone (see Figure 2.2-3)	Quaternary Fault Zone (see Figure 2.2-4)	Flood Zone (Site-specific Review)
Bailly, IN			
Barnwell, SC			
Bellefonte, AL			
Cherokee, SC			
Clinch River Industrial Site, TN			
Columbia, SC	X		
Erwin, TN			
Forked River, NJ			
Hartsville, TN			
Lynchburg, VA			
Marble Hill, IN			
Metropolis, IL	X		
Midland, MI			
Morris, IL			
Oak Ridge, TN			
Paducah, KY	X		
Phipps Bend, TN			
Portsmouth/Piketon, OH			
Savannah River, SC			
Sterling, NY			
Wilmington, NC			
Yellow Creek, MS			

Table 2.2-5. Coarse Screening Results

Site Name	Property Size	Government-owned Sites (County, State, or Federal)	Sites under Litigation	CERCLA Superfund NPL Sites	RCRA Corrective Action Facilities
Bailly, IN			X		
Barnwell, SC		X			
Bellefonte, AL		X			
Cherokee, SC					
Clinch River Industrial Site, TN		X			
Erwin, TN	X				
Forked River, NJ			X		
Hartsville, TN		X			
Lynchburg, VA					X
Marble Hill, IN			X		
Midland, MI			X		
Morris, IL					
Oak Ridge, TN		X		X	
Phipps Bend, TN		X			
Portsmouth/Piketon, OH		X			X
Savannah River, SC		X		X	
Sterling, NY		X			
Wilmington, NC					
Yellow Creek, MS		X			

NOTE: The highlighted sites entered the site-reconnaissance step, which resulted in Cherokee, SC, being eliminated prior to entering the fine-screening phase.

Table 2.3-1. Potential Cumulative Effects

Report Section[a]	Resource	Potential Cumulative Effects
4.1	Land Use	▪ Land use impacts resulting from the construction, operation, and decommissioning phases of the Proposed GLE Facility should be considered cumulative because once the land is cleared for construction of the Proposed GLE Facility, it likely would remain used as a site for industrial facilities. ▪ Cumulative land use impacts resulting from the Proposed GLE Facility combined with the existing and other planned land uses for the Wilmington Site would be SMALL. ▪ Addition of the Proposed GLE Facility to the Wilmington Site should have a SMALL impact on changing planned or future land use at other land parcels in the surrounding vicinity or region.
4.2	Transportation	▪ Transportation impacts resulting from traffic increases would not be cumulative over the construction, operation, and decommissioning phases of the Proposed Action; therefore, cumulative effects are considered SMALL. ▪ The impact on traffic flow in the immediate vicinity of the interchange with U.S. Interstate Highway 140 (I-140) from the cumulative daily vehicle trips that would be generated by the Proposed GLE Facility, combined with the vehicle traffic from existing Wilmington Site facilities and other planned on-site and off-site projects identified in **Section 2.3** of this Report (*Cumulative Effects*) would be MODERATE. ▪ On a regional basis, the cumulative transportation impacts for the Proposed GLE Facility are expected to be SMALL.
4.3	Geology and Soils	
4.3.1	Site Soils	▪ Cumulative shallow soils impacts (e.g., grading, excavation, change in runoff and erosion) from the Proposed Action and the other planned on-site projects identified in **Section 2.3** of this Report (*Cumulative Effects*) are expected to be SMALL.
4.3.2	Geological Impacts	▪ The cumulative geological impacts to the Proposed GLE Facility during the construction and operation phases would be SMALL and would be controlled by engineering designs.
4.4	Water Resources	
4.4.1	Groundwater	▪ SMALL cumulative groundwater quality impacts are anticipated from the combined construction, operation, and decommissioning phases of the Proposed GLE Facility. ▪ The cumulative impacts on groundwater quality from stormwater runoff, treated sanitary and process wastewater effluents, and relatively minor changes in groundwater elevations and flow patterns from the other planned on-site projects identified in **Section 2.3** of this Report (*Cumulative Effects*) from the Proposed GLE Facility are anticipated to be SMALL.

(continued)

Table 2.3-1. Potential Cumulative Effects (continued)

Report Section[a]	Resource	Potential Cumulative Effects
4.4.2	Surface Waters	▪ Direct and indirect cumulative impacts to surface water quality from construction and operation of the other planned on-site projects identified in **Section 2.3** of this Report (*Cumulative Effects*) from the Proposed GLE Facility would be SMALL. ▪ The cumulative treated process wastewater effluents from the Proposed Action, the Advanced Technology Center (ATC) II complex, and the Tooling Development Center would be discharged to the effluent channel. The system that allows for the reuse of the Wilmington Site's treated sanitary wastewater as make-up water in Wilmington Site cooling towers enables the switch away from the direct discharge of the treated sanitary wastewater effluent to the effluent channel. Surface water quality cumulative impacts from effluent discharges are anticipated to be SMALL. ▪ Additional information on the construction plans, National Pollutant Discharge Elimination System (NPDES) requirements, and stormwater management practices of the planned adjacent River Bluffs continuing care retirement community would be required to assess the cumulative surface water impact anticipated. ▪ The off-site industrial project identified in **Section 2.3** would be located approximately 20 river miles upstream of the Wilmington Site. Potential impacts to surface waters from this project have not yet been assessed. However, GE-Hitachi Nuclear Energy (GEH) monitoring station UPST would be located between the off-site industrial project and the Wilmington Site. Therefore, any changes to surface water quality could be distinguished from potential impacts from the Proposed GLE Facility.
4.4.3	Floodplains	▪ The ATC II complex and the Tooling Development Center would not impact the floodplain boundaries; however, SMALL indirect impacts may occur due to increase in magnitudes of floodwaters from Site runoff as more vegetated land is converted to impervious surfaces. The cumulative impact from all on-site projects would be SMALL. ▪ Cumulative impacts to the floodplains of the Northeast Cape Fear River and its tributaries from the Proposed GLE Facility and the other planned off-site projects identified in **Section 2.3** of this Report (*Cumulative Effects*) are expected to be SMALL.
4.4.4	Wetlands	▪ Cumulative loss of wetlands is not expected from the Proposed Action and other on-site planned projects; therefore, the cumulative impacts to wetlands are expected to be SMALL. ▪ Indirect impacts may occur to a wetland area located along the South-Central Site Sector property line from increased runoff and decreased buffer from the planned adjacent River Bluffs development. ▪ The off-site industrial development identified in **Section 2.3** of this Report (*Cumulative Effects*) would impact approximately 493 acres (199 hectares [ha][) of wetlands, but the nature of these impacts has not yet been assessed. The potential for loss of wetlands from this off-site industrial development emphasizes the importance that the Proposed Action would avoid most wetland impacts.

(continued)

Table 2.3-1. Potential Cumulative Effects (continued)

Report Section[a]	Resource	Potential Cumulative Effects
4.4.5	Water Use	▪ SMALL cumulative water-use impacts are anticipated from the combined construction, operation, and decommissioning phases. ▪ Treated sanitary wastewater effluent is planned for industrial re-use as process operations, thus reducing groundwater withdrawal for process-water requirements. There is also SMALL risk for adverse cumulative impacts on neighboring residential wells and the groundwater supply from the Proposed GLE Facility and the ATC II complex and Tooling Development Center.
4.5	Ecological	▪ No federally threatened or endangered species are known to exist on the Wilmington Site, including at the areas of the Proposed GLE Facility and the other planned on-site projects identified in **Section 2.3** of this Report (*Cumulative Effects*); therefore, cumulative impacts from these actions on endangered or threatened species would be SMALL. ▪ No known threatened or endangered species are currently recorded for the area of the planned adjacent River Bluffs development; therefore impacts from the Proposed Action and the planned adjacent River Bluffs development are expected to be SMALL. ▪ The off-site industrial project identified in **Section 2.3** would also potentially impact floodplain habitat that is home to a diverse community of plants and animals, an important nursery area for fish and a migratory bird refuge. However, the Proposed Action would only have minor impacts to these rare and unique communities, nursery area, and migratory bird habitat; therefore cumulative impacts to ecological resources from the Proposed Action and the off-site industrial project would be SMALL.
4.6	Air Quality	▪ The air quality impacts resulting from incremental air emissions increases would not be cumulative over the construction, operation, and decommissioning phases of the Proposed GLE Facility. ▪ The cumulative air quality impacts from the Proposed Action and other planned on-site and off-site projects identified in **Section 2.3** of this Report (*Cumulative Effects*) are not expected to substantially change any air quality impact assessments already accounted for by New Hanover County long-range regional land use and transportation growth plans; therefore, the cumulative air quality impacts would be SMALL.
4.7	Noise	▪ Noise impacts would not be cumulative over the construction, operation, and decommissioning phases of the Proposed GLE Facility. ▪ Cumulative impacts from the existing ambient and Facility noise combined with the noise from the Proposed GLE Facility are expected to be SMALL.

(continued)

Table 2.3-1. Potential Cumulative Effects (continued)

Report Section[a]	Resource	Potential Cumulative Effects
4.8	Historical and Cultural	▪ Cumulative impacts from paving and minor increased use of an existing gravel road adjacent to a discovered prehistoric archaeological site would be SMALL when evaluating the construction, operation, and decommissioning phases of the Proposed Action together. ▪ No archeological sites are known to exist at the areas of the Proposed Action and other planned on-site projects; therefore, cumulative impacts from these actions on historical and cultural resources are expected to be SMALL. ▪ If no additional historical or cultural resources are identified for the planned adjacent River Bluffs development, the cumulative impacts on historical and cultural resources from the Proposed Action and this community would be SMALL.
4.9	Visual/Scenic Resources	▪ Cumulative impacts on the visual and scenic resources from the combined construction, operation, and decommissioning phases of the Proposed Action would be SMALL. ▪ The cumulative visual/scenic resources impact of the Proposed GLE Facility with the existing Wilmington Site facilities and other planned on-site projects would not represent a significant change in the overall visual character and value of the landscape in the vicinity of the Wilmington Site and would be considered SMALL. ▪ No other known new projects planned for development in the immediate vicinity of the Wilmington Site would add to the visual intrusions in the existing landscape and skyline around the Site; therefore cumulative impacts would be SMALL.
4.10	Socioeconomic Impacts	▪ The cumulative socioeconomic impacts from the Proposed Action and the other planned on-site and off-site projects identified in **Section 2.3** of this Report (*Cumulative Effects*) are expected to be to be SMALL to MODERATE, depending on the timing of their construction and operation.
4.11	Environmental Justice	▪ The overall cumulative environmental impacts experienced by residents from the construction, operation, and decommissioning phases of the Proposed Action would be SMALL, and any adverse health impacts would be SMALL. These SMALL cumulative impacts are not expected to fall disproportionately on either minority or low-income residents of the area. ▪ The overall cumulative impacts from the Proposed Action and other planned on-site and off-site projects identified in **Section 2.3** of this Report (*Cumulative Effects*) are anticipated to be generally SMALL. These SMALL cumulative impacts are not expected to fall disproportionately on either minority or low-income residents of the area.
4.12	Public and Occupational Health	▪ The cumulative effects of construction, operation, and decommissioning of the Proposed GLE Facility on public and occupational health from radiological and non-radiological exposure are anticipated to be SMALL. ▪ Cumulative radiological and non-radiological impacts from the Proposed GLE Facility and other existing and planned on-site facilities and off-site projects identified in **Section 2.3** are expected to be SMALL.

(continued)

Table 2.3-1. Potential Cumulative Effects (continued)

Report Section[a]	Resource	Potential Cumulative Effects
4.13	Waste Management	▪ The impacts from management of wastewaters and solid wastes would not be cumulative over the construction, operation, and decommissioning phases of the Proposed Action with one exception: solid wastes sent off-site to a facility for landfill disposal would cumulatively consume a portion of the permitted landfill capacity limit. These cumulative impacts would be SMALL. ▪ It is anticipated that the cumulative impacts on national depleted uranium conversion facility operations and LLRW disposal facility capacity from the generation, off-site conversion to uranium oxide, and ultimate disposal of depleted uranium from the Proposed GLE Facility would be SMALL. ▪ Cumulative wastewater, stormwater, and solid wastes management impacts of the Proposed GLE Facility with the other planned on-site and off-site projects identified in **Section 2.3** would be SMALL.

[a] Refer to **Chapter 4** of this Report (*Environmental Impacts*) for a more detailed discussion of impacts.

Table 2.4-1. Comparison of Potential Impacts to Domestic Capacity and Supply for the Proposed Action and the No Action Alternative

Potential Impact	Proposed Action	No Action Alternative
Domestic Capacity	The initial target production as a result of the Proposed Action would be 6 million Separative Work Units (SWU) and could help meet the projected shortfall in domestic capacity.	Current U.S. demand for enriched uranium is approximately 13 to 14 million SWU per year (EIA, 2007b; WNA, 2008b) and could reach 15 to 16 million SWU by 2025 (ERI, 2006; NUKEM, 2006). ▪ United States Enrichment Corporation, Inc. (USEC) – approximately 6.7 million SWU of total production is sold for use in the United States (from Paducah and Megatons-to-Megawatts Program [expires in 2013]) ▪ Proposed Louisiana Energy Services, L.P. (LES) National Enrichment Facility (NEF) – 3 million SWU ▪ Proposed USEC American Centrifuge Plant (ACP) – 3.5 million SWU ▪ AREVA NC, Inc. – intent to apply, in fiscal year (FY) 2008, for a license to construct and operate a 3 million SWU/year gas centrifuge enrichment plant Without the additional capacity of the Proposed GLE Facility, the anticipated demand for additional SWU capacity may not be met, and the United States may remain largely dependent on foreign suppliers of enrichment services.
Domestic Supply	1. The Proposed Action would meet the need for enriched uranium to fulfill nuclear electrical generation requirements.	1. Under the No Action Alternative, future nuclear electrical generation requirements can not be met. The demand for enriched uranium is a function of nuclear power generating capacity. Presently, nuclear power plants supply approximately 20% of the nation's electricity requirements (EIA, 2007a). In a 2007 report, the IEA predicted that global primary energy demand will increase by more than 50% by 2030 (IEA, 2007). 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).
	2. The Proposed Action would meet the need for domestic uranium-enrichment capacity for national energy security.	2. Under the No Action Alternative, important national energy security policy objectives would not be furthered by construction and operation of the Proposed GLE Facility. The Proposed GLE Facility (as well as the proposed NEF and ACP facilities) would help the nation's ability to maintain a reliable and economical domestic source of enriched uranium. The U.S. 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]).
	3. The Proposed Action would meet the need for advanced uranium enrichment technology in the United States.	3. Under the No Action Alternative, enriched uranium would continue to be produced by technologies (gaseous-diffusion and gas centrifuge processes) with higher operating costs and significantly higher capital costs. 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. This would not be accomplished under the No Action Alternative.

Figures

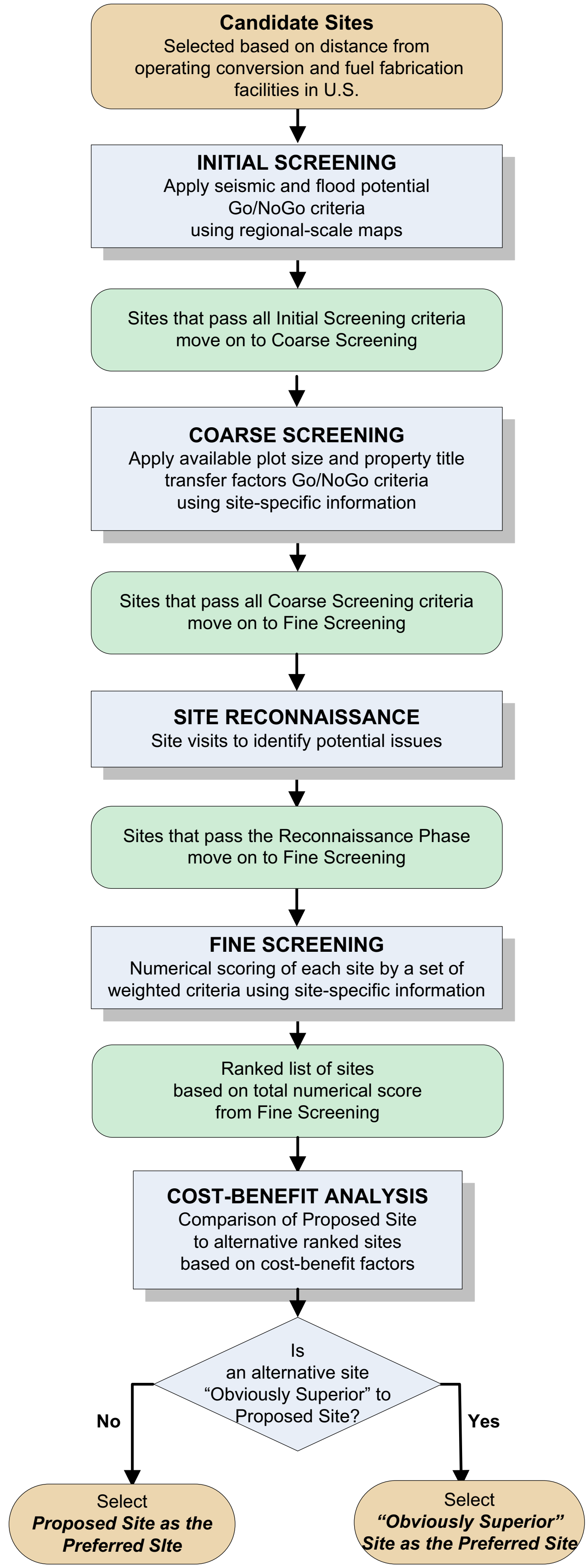

Fig 2.2-1. Site selection methodology.

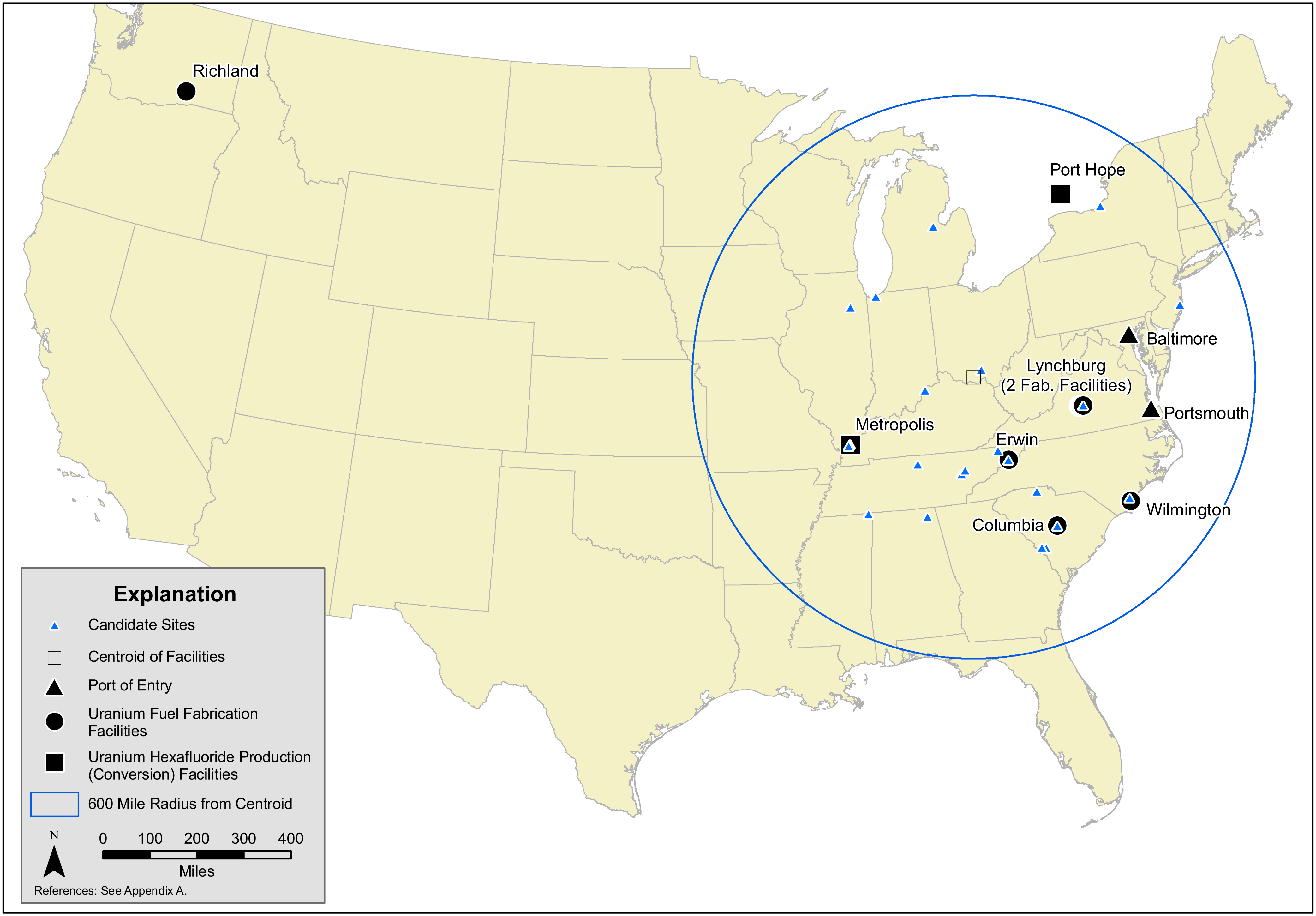

Figure 2.2-2. Candidate sites.

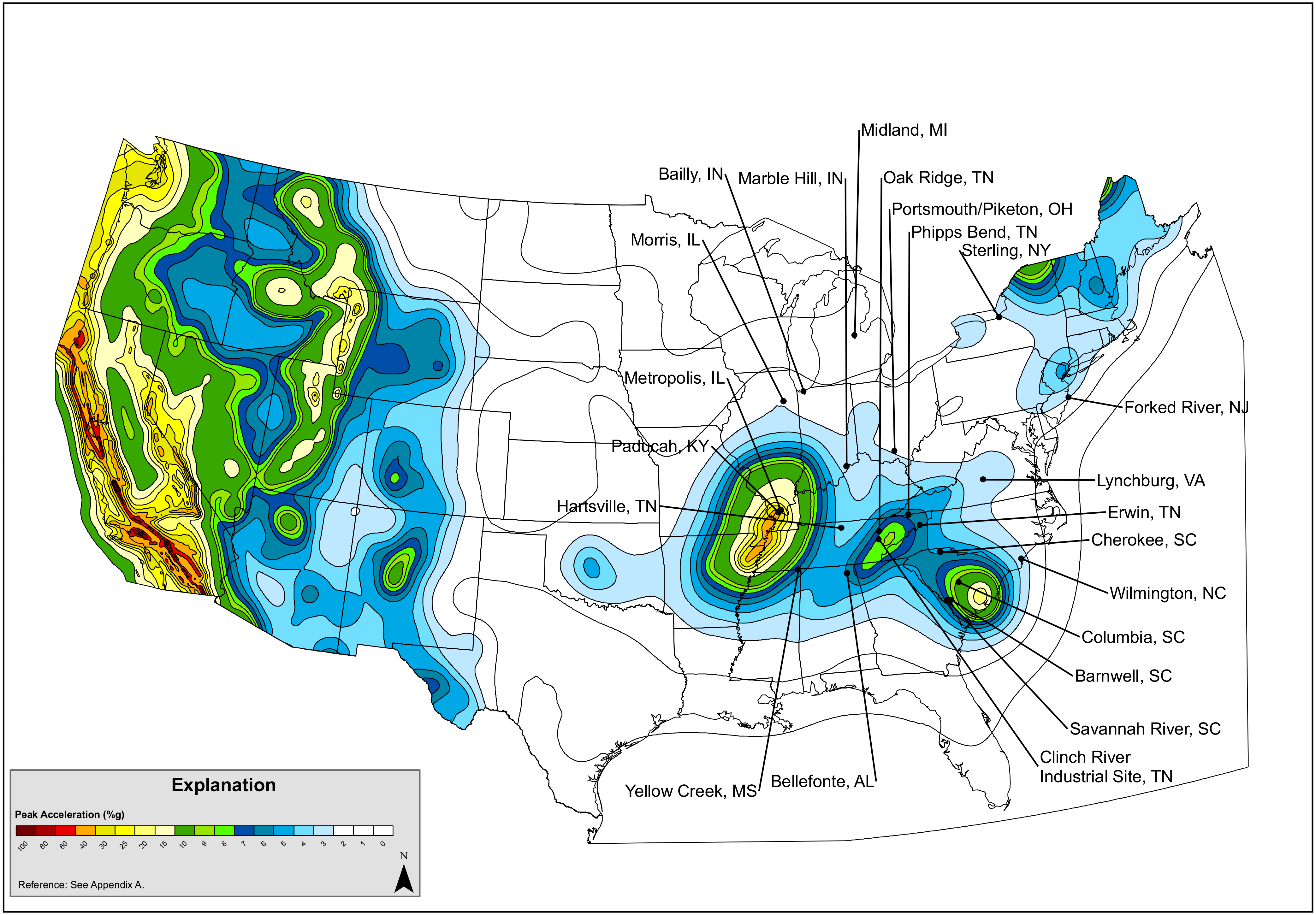

Figure 2.2-3. Seismic hazard map (10% probability of exceedance in 50 years).

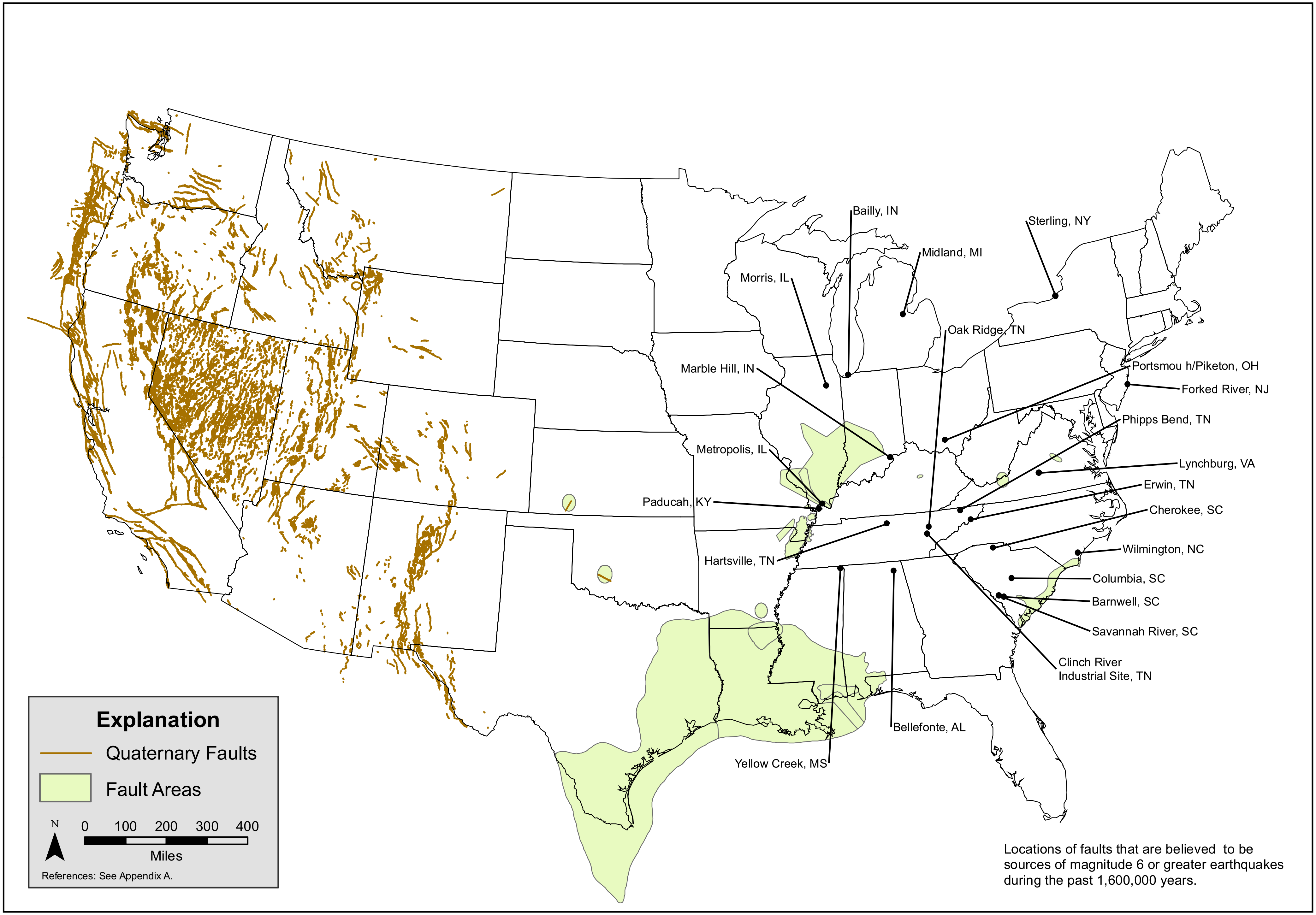

Figure 2.2-4. Quaternary faults.

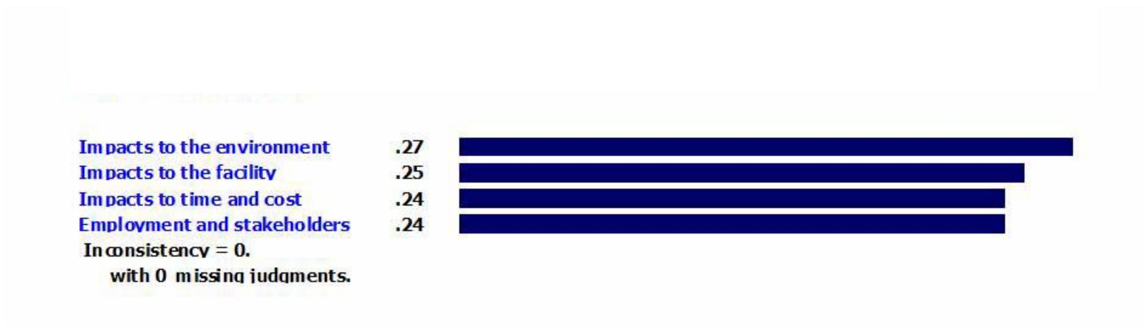

Figure 2.2-5. Weighting results.

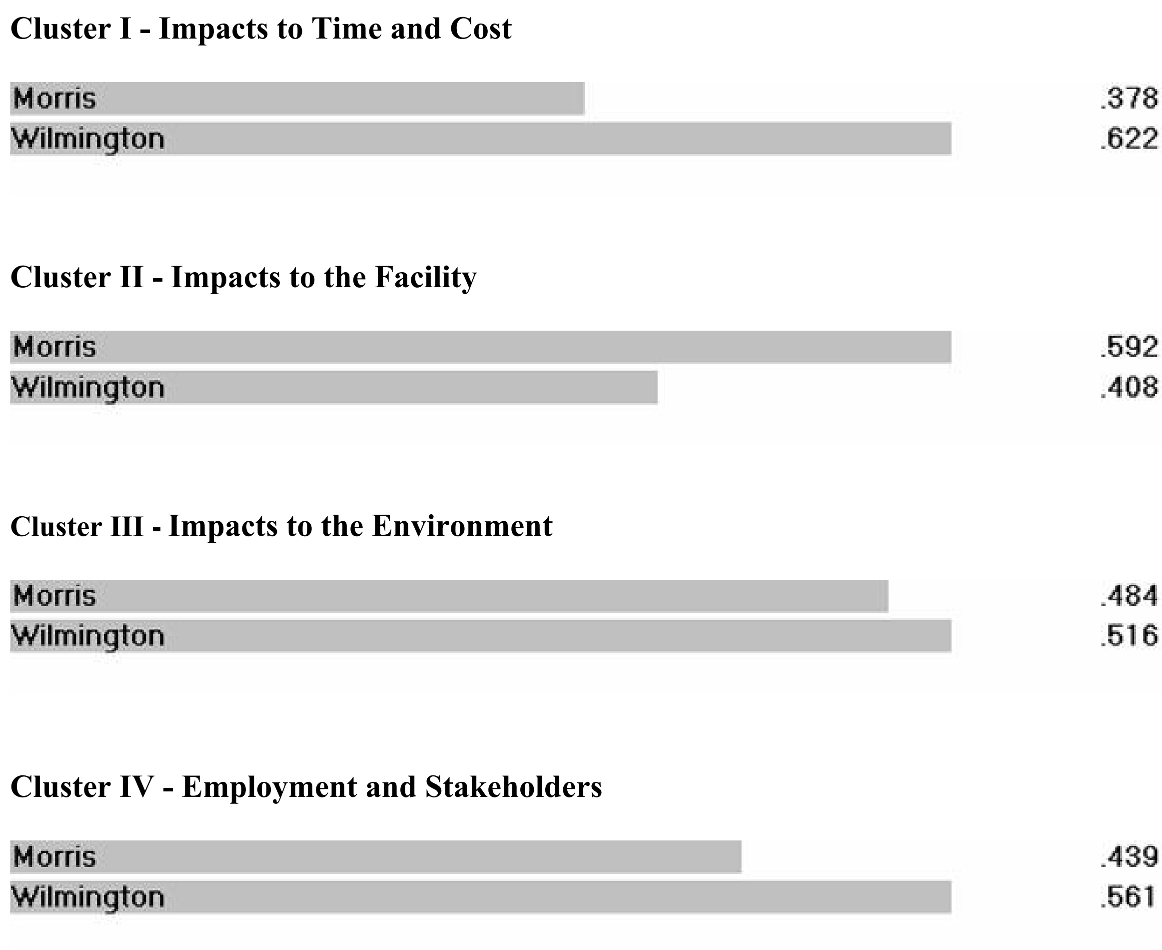

Figure 2.2-6. Ranking results.

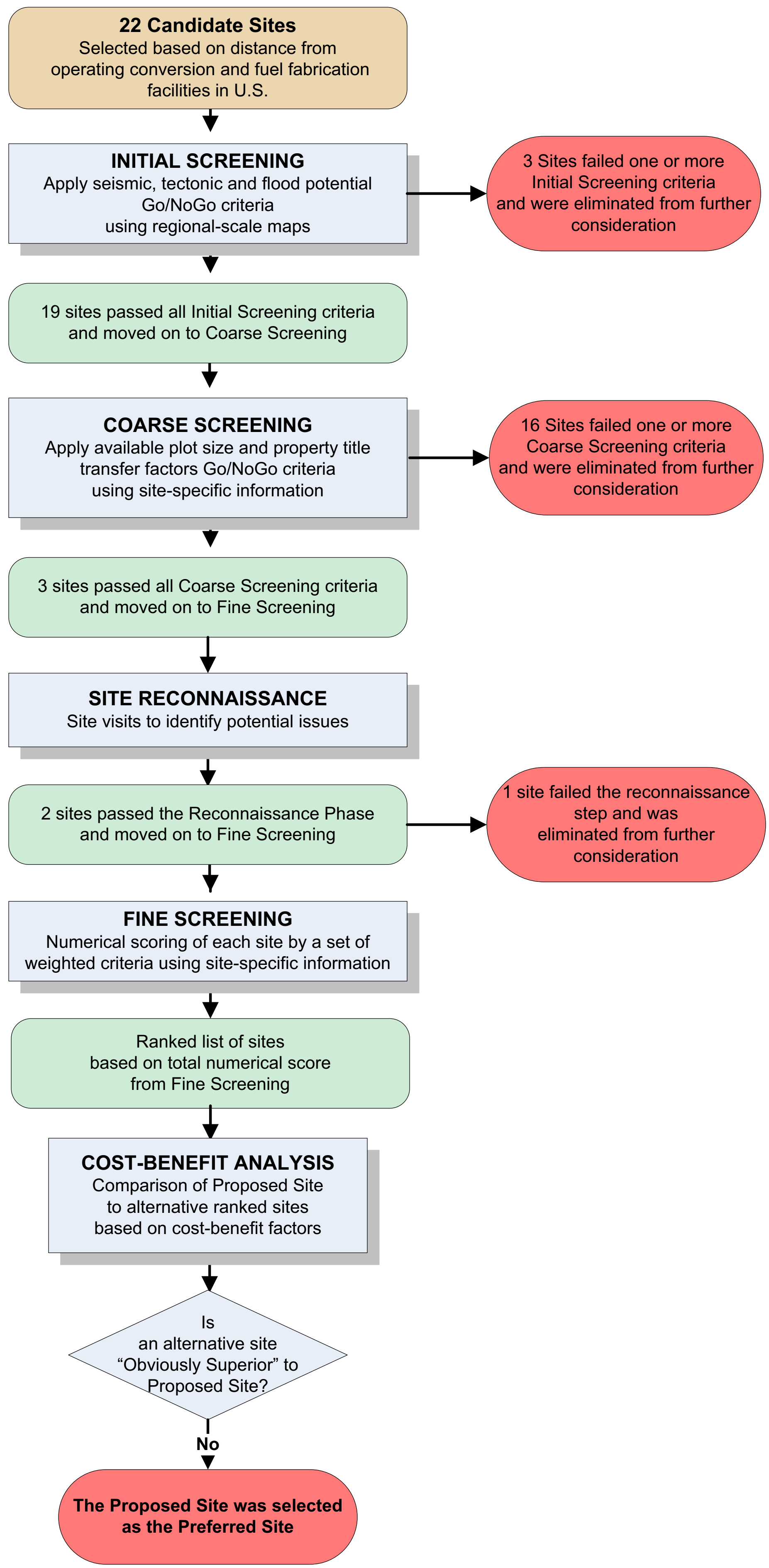

Fig 2.2-7. Site selection results summary.